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OUTPUT AND EARNINGS OF A HYDROELECTRIC PLANT.

It is estimated that the annual output of a recently completed hydroelectric plant on one of our large rivers will be 50,000,000 kilowatt-hours delivered to consumers, and that this energy will yield an average income of one cent per kilowatt-hour, or a total of $500,000 per year gross earnings.

This estimate is based on a generating capacity of 16,000 kilowatts, and a transmission of most of the energy to markets that are forty to seventy-five miles from the waterpower plant.

It may be noted here that the output of 50,000,000 kilowatt-hours corresponds to 3,125 kilowatt-hours yearly per kilowatt of generating capacity, and the income of $500,000 annually represents $31.25 per kilowatt of capacity. As the transmission was estimated at an efficiency of eighty per cent, the 3,125 kilowatt-hours sold annually corresponds to 3,906 kilowatt-hours generated per kilowatt of capacity, and this gives a load factor of forty-four and five-tenths per cent during the 8,760 hours of a year. Of the 62,500,000 kilowatt-hours generated to deliver 50,000,000 kilowatt-hours to consumers at an efficiency of eighty per cent in transmission, it is necessary to develop 5,808,000 kilowatt-hours, or nine per cent with steam, in an average year.

For this hydroelectric plant complete with transmission system the estimated cost is $2,500,000, or $156 per kilowatt of generating capacity, on which the interest charge at six per cent is $150,000 annually. Yearly expenses are put at a total of $153,000 for operation, including $60,000 for steam power at one cent per kilowatt-hour, and in addition two per cent on the total cost of $2,500,000, amounting to $50,000, for depreciation.

On the above estimate, the annual earnings of $500,000 show an excess of $147,000 over the $353,000 of running expenses, interest and depreciation.

The rates suggested for continuous power were 1.0 to 1.2 cents per kilowatt-hour to consumers using 150 to 300 horsepower, and 1.2 to 2.0 cents per kilowatt-hour to those using less than 150 horsepower. Consumers using much larger powers might be given lower rates to bring the average down to the above estimate of one cent per kilowat-hour.

In the river where this plant is located the ratio of maximum to minimum discharge is more than seventy to one, and it is estimated that floods may be great enough to stop

operation once in twenty-five years. For the purpose of keeping up the output of the plant at times of high water, when the operating head will be decreased by a greater rise of water below than above the dam, each generator is connected with three turbine wheels. When the normal head of water is available at the dam, water is admitted to only two of the wheels connected to each generator, but when the head is low the third wheel is opened, so that the grater volume of water compensates in part for the loss of head.

Apart from the use of steam power, the estimated output of the hydroelectric plant is 56,875,000 kilowatt-hours at the switchboard, during an average year. This output amounts to 3,554 kilowatt-hours yearly per kilowatt of generating capacity, and to a load factor of 40.5 per cent of the capacity of 16,000 kilowatts during the 8,760 hours of a year. Of the total output, 31,875,000 kilowatt-hours is assumed to be generated as constant power, corresponding to an output of 97,200 kilowatt-hours on each of 365 days, less 3,603,000 kilowatt-hours not generated on Sundays. The remaining 25,000,000 kilowatt-hours of annual output is assumed to be generated as non-constant power, and represents the output of 94,800 kilowatt-hours on each of 365 days, minus 5,808,000 kilowatt-hours for days when sufficient water is not available and 3,794,000 kilowatt-hours not generated on Sundays.

For both the constant and the non-constant power, the estimated output is 192,000 kilowatt-hours on each of 365 days, amounting to 70,080,000 minus 5,808,000 kilowatt-hours for days when sufficient water was not available and 7,397,000 units not generated on Sundays, leaving the total generated energy at 56,875,000 kilowatt-hours for the year, as above. During the average year under consideration, the flow of water in the river is sufficient for the generated output of 192,000 kilowatt-hours per day, corresponding to an average load of 8,000 kilowatts for the twenty-four hours, on 240 days. This average load represents a load factor of fifty per cent of the 16,000 kilowatt generating capacity.

On the remaining 125 days of a year, the generated output per day is 192,000 to 97,200 kilowatt-hours, according to the flow of water available. The latter figure, that may be generated on each day as constant power, corresponds to an average load of 4,050 kilowatts during the twenty-four hours, and this is the minimum power of the average year.

During such a year the sales of energy amount to 45,500,000 kilowatt-hours, or eighty per cent of the 56,500,000 kilowatt-hours generated, and this volume of sales is 2,843 kilowatt-hours per kilowatt of the 16,000 kilowatts of generating capacity. Of the energy sold, 25,500,000 kilowatt-hours is sold as constant power, being eighty per cent of the 31,875,000 kilowatt-hours generated at the rate of 97,200 kilowatt-hours per day, Sundays excepted. The other 20,000,000 kilowatt-hours sold is eighty per cent of the 25,000,000 kilowatt-hours generated as non-constant power.

For fifty-two Sundays of an average year the generated output amounts to 9,984,000 kilowatt-hours, on the basis of an average load of 8,000 kilowatt-hours, or 192,000 kilowatt-hours output per day. But a total of 7,397,000 kilowatt-hours was deducted above as not generated on Sundays, due to lack of water and lack of load, so that the energy actually generated on the fifty-two Sundays aggregates 2,587,000 kilowatt-hours, or 49,750 per Sunday, amounting to an average twenty-four-hour load of 2,072 kilowatts, or 12.19 per cent as a load factor, compared with the load factor of 40.5 per cent for the 8,760 hours of the year.

In a year of minimum river discharge, the estimate of total energy generated is 50,000,000 kilowatt-hours, corresponding to 3,125 kilowatt-hours per kilowatt of generating capacity, and to a load factor of 35.6 per cent with 16,000 kilowatt capacity during the 8,760 hours of a year.

Of the total generated output, 22,500,000 kilowatt-hours is delivered as constant power at the rate of 61,500 kilowatt-hours on each of 365 days, corresponding to a load of 2,562 kilowatts during the 8,760 hours of the year. This load requires the least discharge of the river in the minimum year. As non-constant power in this year there is generated 27,500,000 kilowatt-hours, corresponding to a uniform load of 5,438 kilowatts during 365 days, minus 16,653,000 for which water is not available and 3,427,000 not required on Sundays. For the full load of constant and non-constant power, amounting to 8,000 kilowatts, there is water available in the river on 191 days of the minimum year, and on the other 174 days the load decreases to the 2,562 kilowatts of constant power.

Sales of energy total 40,000,000 kilowatt-hours for this year, or eighty per cent of the energy generated, and these sales reach 2,500 kilowatt-hours per kilowatt of generating capacity. Of the total sales, 18,000,000 kilowatt-hours represents constant and 22,000,000 non-constant power.

The above estimates apply to a hydroelectric plant at a point on a river where the normal operating head is about thirty-two feet, and where the minimum discharge of water probably was as low as 1,000 cubic feet per second. With such a flow at this head the gross rate of work is 3,630 horsepower, or 2,722 kilowatts. At a station efficiency of seventy-one per cent the output at the minimum run of the river is thus 1,932 kilowatts.

COAL-HANDLING MACHINERY.

The economies incident to the installation of coal-handling machinery in factories and power plants, are not so generally understood as might the case. A striking example of economy is instanced by the new coal-handling equipment of the dock at the pumping station of the Poughkeepsie (N. Y.) water works, by which the cost of unloading coal has been reduced from fourteen cents to slightly more than one cent a ton. This equipment was not expensive, for, excluding the foundations, the total cost was only $2,500.

An article on coal-handling machinery appeared in the New Year's issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, and it is expected that more information on this subject will be published from time to time. Most central-station men will find much room for further economy in the handling of their coal and ashes, and articles dealing with this topic should be carefully noted.

THE TREATMENT OF FEED WATER.

Very few steam-driven electric-generating plants have available a supply of feed water which is so free from impurities that it will not deposit scale in the boilers. The effect of this scale on the transmission of heat from the furnace to the water in the boiler, although far from being thoroughly understood, is exceedingly detrimental, both to economy of operation and to the life of the boiler. This will be admitted without question, for a given heat gradient will cause more heat to pass through a scale-free plate than through a plate that is thickly incrusted with scale, and, furthermore, the dangers of unequal expansion of the boiler plates are more pronounced in the latter case than in the former on account of local overheating. Thus it is apparent that feed water should be treated to remove from it the impurities that would cause the deposition of scale, before the water is fed to the boilers.

In an article entitled "Heat Transmission and Fuel Economy," which appeared in a recent issue of *The Electrical Review*, of London, England, Mr. P. J. Pringle gives an interesting and instructive account of how a close attention to the improvement of methods in the boiler house of the electrical undertaking with which he is associated, resulted in some startling economies. One of the principal improvements effected was the installation of a water-softening plant with a capacity of 4,000 gallons an hour. This, in conjunction with periodical scrapings of the boiler tubes (Lancashire boilers are used in the plant under discussion), resulted in a saving of fuel per kilowatt-hour of energy sold, of no less than 13.6 per cent, and this in spite of the fact that a poorer quality of fuel was used in the period under review than was previously the case. The amount of fuel saved was 900 tons in eight months. Mr. Pringle estimated the cost of the boiler-scraping process at $3.75, and as scraping was only resorted to once every two months, this item of expense is almost negligible and in fact was nearly balanced by the saving due to the reduced tonnage of fuel and ashes handled in the plant.

Other important points in connection with the feeding of steam boilers are the temperature of the feed, and the manner and place of its entry into the boiler. If the entering feed water is hot, the place of entry is almost immaterial except in so far as matters of expediency (as of draining the boiler in case of emergency) are concerned. On the other hand, if the feed water is cold, it should enter where it will not impinge on too hot a surface, in order to minimize as far as possible the effect of contraction of the hot plates. If the cold water is led into the boiler near the top, it is obvious that in general a better circulation of the water in the boiler will result, than if the water enters near the bottom; and, again, in the former case, a better thermodynamic efficiency should be attained by reason of the fact that heat will probably be added to the water in more gradual increments.

In most cases it will prove more economical to heat the feed water before it is injected into the boiler. A simple calculation will show the increased thermodynamic efficiency that will result as a consequence of so doing, apart from the mechanical considerations stated in part above. There are other advantages besides, for, in the case of non-condensing plants, the waste energy of the exhaust steam may thus be utilized, and in other cases, the heat in the flue gases may be put to account by using an economizer for this purpose. There are many types of feed-water heaters on the market, and some of these include features for depositing the sediment present in the water, and for filtering and straining the water before it is drawn off by the feed pipe to the boiler.

In conclusion it may be noted that no universal treatment may be devised that will be applicable to all waters and to all boilers. Each kind of water should be carefully analyzed and experimented with so that a suitable treatment may be devised for it, and no two boilers were ever made so much alike, even from the same design, that they operated exactly in the same manner. The intelligent boiler attendant, however, will usually be able to administer correctly, after some trial and effort, to the various peculiarities of the boilers under his charge. By careful observation and examination of test results many economies in boiler operation will be effected, and it may safely be said that in no part of a steam-driven plant may so large a saving be made as in the boiler room.

THE ECONOMICS OF THE LEATHER BELT.

Although the leather belt is fast disappearing under the continuous encroachment on its domain of the electric-motor direct drive, there are still many instances where its use will be apparent, as in driving electric generators from gas engines, etc. The proper treatment and use of the leather belt, therefore, are of interest to the electrical and mechanical engineer.

In a recent issue of *The Mechanical Engineer*, of Manchester, England, Mr. Y. Sekiguchi gave an account of some investigations on leather belts. Tests showed that the hair side of the belt is more elastic than the flesh side, while the latter is the stronger and also has a higher coefficient of friction with the rim of the pulley. The conclusions drawn were substantially as follows: Ordinarily, put the flesh side next the pulley. When the diameters of the pulley are almost alike and flexibility is not so necessary, put the hair side of the belt on the pulley to keep the stronger side of the belt away from the rubbing action of the pulley and so increase the life of the belt.

The Philadelphia Electrical Exhibition.

The first electrical exhibition for twelve years in Philadelphia, and the third of its kind held in that city, was opened at the First Regiment Armory, Broad and Callowhill streets, last Monday evening, February 14. The exhibition will be open for two weeks, excepting Sundays.

In fitting accord with the importance of Philadelphia as one of the greatest industrial centers of the world, the exhibition is thoroughly representative of the leading electrical industries of the country, and it is hoped that the electrical show will henceforth become an annual feature.

The general color scheme is in white, gold, and pale blue. The booths are uniform in construction and artistic in design, each of the supporting columns being decorated in white and gold and surmounted by a lion, from the mouth of which depends a string of varicolored incandescent bulbs.

Outside the Armory no less pains have been taken to advertise the show and make it a success. Broad Street, which is probably the finest thoroughfare in the city, has been transformed from the City Hall to the Armory by a blaze of illumination, and thoroughly deserves its appellation of the "Great Light Way." Conspicuous among the decorations are the festoons of electric lights which have been installed especially for this occasion, and a number of large electric signs for advertising the show.

The Philadelphia Rapid Transit Company, which is the largest exhibitor in the show itself, is giving publicity on the city streets by running over its tracks a number of floats which are beautifully decorated and illuminated with electric lights.

Inside the Armory the Rapid Transit Company has a miniature reproduction of the Market Street elevated road, which is attracting much attention. This model railway, which includes a representation of the Sixty-ninth Street loop, has small cars running over its tracks, and the safety signals are shown in actual operation.

The city of Philadelphia has a unique electrical display which includes working models of the electrically operated fire boxes and automatic alarms used in the city.

The University of Pennsylvania has an interesting historic and photographic exhibition, and near by is a restaurant in which all the cooking is done by electricity. The latter is attracting great attention from the ladies who form an enthusiastic audience at the various demonstrations.

A fine programme of classical and popular music is being given daily by Kendall's First Regiment Band and Orchestra, and this feature is doing much to make the show a social and popular success. In fact the whole of the arrangeents reflect much credit on H. E. Rice, the general manager of the exhibition, who has worked assiduously to make the show worthy of the great city in which it is being held.

The leading electrical firms of the country have splendid exhibitions of electrical apparatus and utensils on show at their booths; a full account of these will be given in our next issue. The following is a list of the principal exhibitors:

Commercial Truck Company.
Westinghouse Electric and Manufacturing Company.
Century Electric Company.
Robbins & Myers.
Keystone Telephone Company.
Fort Wayne Electric Works.
Shelton Electric Co.
Keller-McManus.
Duntley Manufacturing Company.
Philadelphia Electric Company.
General Electric Company.
Engineering Equipment Company.
Electric Storage Battery Company.
Simplex Electric Company.
Studebaker Automobile Company.
Edward Miller & Company.
Hurley Machine Company.
Roller-Smith Company.
Sangamo Electric Company.
Williamson Motor Company.
Electrical Contractors' Association.
J. E. Caldwell & Company.
Philadelphia Specialty Company.
Electrical Review and Western Electrician.
Vacuum Engineering Company.
Philadelphia Rapid Transit Company.
Walker Electric Company.
Bailey, S. R., & Company.
Helios Manufacturing Company.
James Barker, Inc.
International Correspondence Schools.
J. C. Bartlett.
Nernst Lamp Company.
Johns-Manville Company.
Federal Sign System.
Invincible Renovator Sales Company.
University of Pennsylvania.
H. T. Paiste Company.
General Vehicle Company.
Western Electric Company.
United Wireless Company.
City of Philadelphia Electrical Bureau.
Judson C. Burns.
H. I. Samuel.
Auxiliary Fire Alarm Company.
B. F. Sturtevant Company.
H. B. Camp Company.
National Dictograph Company.
Santaria Company.
Nohe Electric Renovator Company.
E. B. Hollinshead.
Simplex Engineering Company.
John G. Lewis.
Wm. K. Krips.
F. B. Thilow.
Collins Wireless Telephone Company.
Anderson Carriage Company.
Metropolitan Engineering Company.
Portable Battery Fan Company.
Otis Elevator Company.
Diehl Manufacturing Company.
G. W. Todd & Company.
Philadelphia Electrical & Manufacturing Company.

Hydroelectric Power Cheaper than Convict Labor Power.

As a result of a recent fire which destroyed the power plant of the Illinois state penitentiary at Joliet, Ill., it has been decided to purchase electricity for light and power from the Sanitary District of Chicago. The former plant will therefore be rebuilt only for heating.

The contract calls for current at one cent per kilowatt-hour and the chief engineer of the penitentiary says that this is fifty per cent less than the rate at which they were able to manufacture electrical power even with convict labor. It is also claimed that purchasing this power will save the state an expenditure of rebuilding the plant of at least $100,000 and in addition thereto save $6,000 annually.

The Sanitary District will supply 6,600-volt, sixty-cycle, three-phase current from its hydroelectric plant between Lockport and Joliet, to the penal institution, where it will be stepped down to the required voltage for lighting and power purposes. Plans are now being formulated for the construction of a suitable substation and in due time all the former direct-current motors will be replaced by alternating-current machines.

The National Club Entertains.

On the evening of Wednesday, February 9, the National Club, of Cleveland, Ohio, composed of the young men of the engineering department of the National Electric Lamp Association, gave a very enjoyable smoker at the club house, 1910 East Fifty-fifth Street, in honor of Section "M" of the National Electric Lamp Association.

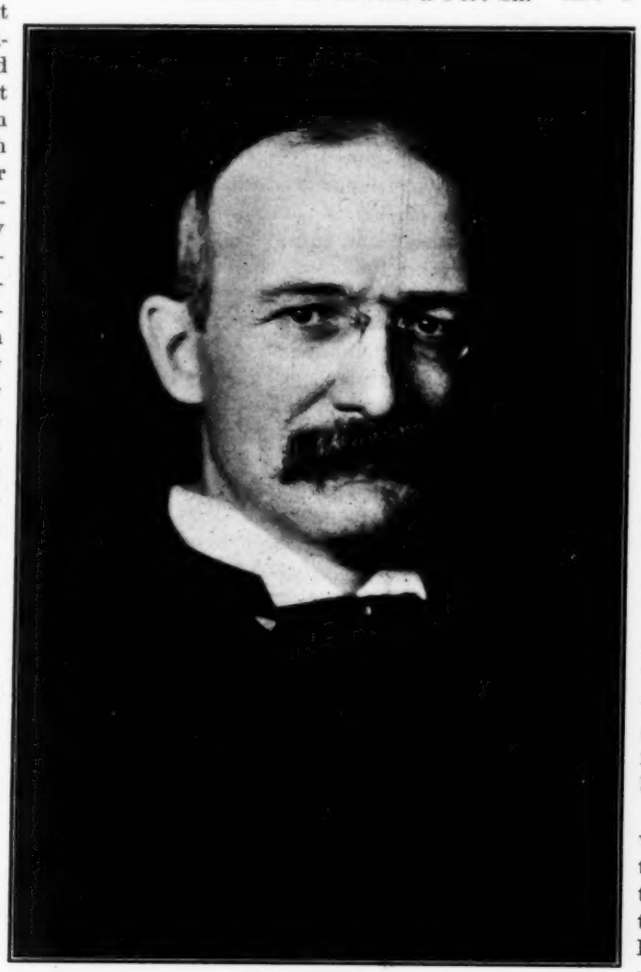
Athletic, vocal and instrumental music, a minstrel show and brief speeches were highly enjoyed. The talent was all furnished by members of the club. The club was addressed by Elmer W. Gillmer, F. S. Terry, B. G. Tremaine and J. Robert Crouse. The master of ceremonies was W. R. Armstrong, assisted by H. S. Lofquist, R. B. Hunter, H. MacPherson, C. O. Brandel, M. Wright and M. I. Skiff, the latter acting as interlocutor in the minstrel show.

H. B. Thayer.

Harry Bates Thayer, who was a few weeks ago re-elected to the presidency of the Western Electric Company, has been continuously associated with that well-known electrical manufacturing organization for over twenty-nine years. During this long period he has actively participated in the rapid evolution of the electrical industry and has come to be known as one of its most successful manufacturers.

Mr. Thayer was born at Northport, Vermont, on August 17, 1858. He completed his scholastic education at Dartmouth College, from which he was graduated with the degree A. B. in 1879. After a brief miscellaneous experience he entered the employ of the Western Electric Company in January, 1881. Continual application to the interests of the company soon brought recognition in steady advancement through many of the departments to positions of more and more responsibility. After holding the office of vice-president for many years, Mr. Thayer was elected president of the company on October 30, 1908, when the veteran president, Enos M. Barton, retired from his more active duties and became chairman of the board of directors. Mr. Thayer is an executive who commands the highest regard of his subordinates, as in fact he does of all who come in contact with him.

Like many men of large affairs, Mr. Thayer is also a director of several corporations besides the one he heads; among these are the Western Union Telegraph Company, the Tabulating Machine Company, the Mexican Telephone and Telegraph Company and a number of the associated Bell telephone companies. He is a member of the New York Chamber of Commerce, the New England Society, the American Institute of Electrical Engineers, and the University Club of New York. Although he makes frequent trips to the large Chicago plants of his company, Mr. Thayer continues to regard New York city as his official headquarters and residence.



H. B. THAYER,
President of the Western Electric Company.

Electrical Projects Before Congress.

The following measures have been introduced in Congress at Washington, D. C., for electrical developments:

A bill to grant to the Siletz Power and Manufacturing Company the right to construct, operate and maintain a canal in the Siletz Indian Reservation, Oregon, the work to be completed wtihin three years after the passage of the act.

To authorize the Lawton & Fort Sill Electric Railway Company to survey, locate and construct, maintain and operate a railway, telegraph, telephone and trolley lines through the Fort Sill Military Reservation, Comanche County, Oklahoma.

To extend the time permit granted to the Edison Electric Company for the completion of electric power plants in San Bernardino, Sierra and San Gabriel forest reserves, California, for a period of five years from May 1, 1910.

Mackay Companies to Sell Telephone Interests.

A wire received from New York last Wednesday states that the Mackay Companies are going to sell their holdings in the American Telephone and Telegraph Company, which in turn has a very large interest in the Western Union. This proceeding, if carried out, will effectually dispose of the great "billion-dollar" merger, and should insure a spirited rivalry between the Postal Telegraph-Cable and the Western Union companies. According to the statement issued to the press, "The Postal Telegraph system will continue to be free and independent, prepared to maintain the competition which it has furnished for twenty-five years."

It will be remembered that when, several months ago, the American Telephone and Telegraph Company bought out George Gould's stock in the Western Union, Clarence Mackay denied the persistent rumor of the great merger. The above announcement apparently puts an end to the controversy.

Battery Cars in New York.

Joseph B. Mayer, receiver for the Twenty-eighth and Twenty-ninth Street crosstown lines, New York city, is giving the first test of the perfected Edison electric storage battery car.

This test will last two weeks and if found practical the receiver will order nineteen extra cars and eliminate the horse-car system entirely. Heretofore this line has been run by the receiver merely to hold the franchise, and the majority of the business has gone to the other crosstown lines. Whether or not these cars will be paid for by issuance of receivers' certificates has not been decided.

Storage Batteries for Emergency Lighting in New York Subways.

A late wire from New York states that the New York Public Service Commission has ordered all subway cars to be equipped with storage batteries to supply current for emergency lighting.

Chicago Electric Club.

Owing to the fact that the grill room of the Chicago Automobile Club is being remodeled, the Chicago Electric Club met on Wednesday, February 9 in the Green Room of the Kuntz-Remmler Restaurant, 303 Wabash Avenue.

The speaker on this occasion was Angus S. Hibbard, vice-president and general manager, Chicago Telephone Company, and his address on "Telephone Traffic and Problems of Chicago" was of a particularly interesting nature.

Mr. Hibbard spoke at length of the organization of the Chicago Telephone Company and the personnel of its employees. He referred to the rapid growth of the telephone industry and demonstrated how its employees had to advance in keeping with this growth. One method of doing this was the organization of technical clubs, in various districts in the city, which held numerous meetings and discussed the telephone problems of the day.

Co-operation between the employees and between the various branches is another important requisite in telephone work, and Mr. Hibbard explained how complete harmony between the plant, traffic, and commercial departments of the company were essential in performing efficient service.

Regarding a few of the problems to be met with, the speaker compared the telephone business with other public service corporations, and taking a lighting company as an example showed how a breakdown of a lighting system affected only the individual or the plant in which the breakdown occurred, whereas, in a faulty telephone all subscribers who wanted to obtain a connection with the party as well as all the subscribers whom the party wanted to call were affected. The complications and details of the telephone were explained by similar comparisons, Mr. Hibbard comparing the ease with which an electric light feeder is tapped as compared with the details of installing a telephone line from a subscriber's instrument to the nearest exchange.

Regarding the question of rates, Mr. Hibbard referred to the various classes of rates which have been in use and subsequently outgrown, and said, that the present nickle box system has proven very popular, and has been the means of greatly expanding the telephone business. There are at present in service something over 80,000 of these instruments, and an average gain of 30,000 telephones a year has been maintained since their inauguration. This means that the company must install at least 60,000 telephones a year as the general ratio is one telephone removed to two installed.

For the proper connection of the 210,000 telephones now in use, the company has laid conduits in over 614 miles of streets; have 2,685 miles of duct and 600,000 miles of wire.

An interesting feature of telephone work which Mr. Hibbard called attention to was that the company employs what might be called a "prospective" traffic corps, whose duty it is to study existing conditions and report as to the prospective telephone traffic for the guidance of the telephone company in its expansion and future buildings.

Following the address of Mr. Hibbard, George H. Lukes, superintendent, North Shore Electric Company, asked what effect would it have had on the growth of the telephone industry if the nickle boxes had been installed at the customer's expense. Mr. Hibbard, answered, that the fact that the telephone companies incurred the expense of installing telephones had a great deal to do with the large number of subscribers, but as it is necessary for the operating company to own the instruments they could not ask the subscriber to pay for its installation.

The following members of the board of managers were appointed as chairmen of the various committees of the Club:

House committee, A. A. Gray; speakers committee, William E. Keily; membership committee, Robert S. Mitten; entertainment committee, Geo. H. Porter; and finance committee, E. R. Rockwell.

Electrical Show at the University of Illinois.

The third annual electrical show conducted under the auspices of the students of the University of Illinois in the Electrical Building, Urbana, Ill., February 10, 11 and 12, fulfilled in every way the promises of the students that it would be better than any previous show. The efforts of the students were well repaid by the large attendance and the expression of approval heard from all sources.

As was the case in previous shows all apparatus used for all of the exhibits was the direct result of the students' work. The exhibits were arranged so that both the technical and the non-technical visitors found features of interest, there being many displays of an amusing nature.

Among the exhibits pointing out the latest advances in electrical engineering may be mentioned the miniature electric railway, the substation equipment, the comparison of the various types of illuminants, the Bell and automatic telephone exchanges, wireless telegraph stations, electro-plating machines, electric tempering machines, examples of high tension transmission and demonstrations of electric cooking. Also an exhibit of a monorail car.

The exhibits of an amusing character included various "shocking" machines, the freak room, electrical appliances for the nursery, etc.

The success of the show may be attributed largely to the following, who acted in the various capacities mentioned: H. M. Turner, manager; C. H. Reeder, engineer; J. F. Chinlund, business manager; H. H. Reeves, advertising manager; H. A. Moore, assistant engineer; W. J. Putnam, assistant engineer; W. E. East, assistant advertising manager and E. D. Doyle, treasurer.

Sale of Third Avenue Railroad.

The property of the Third Avenue Railroad Company, New York, N. Y., will be sold by Joseph P. Day on Tuesday, March 1, next, in the County Court House, on Chambers Street, Borough of Manhattan, at 12 o'clock noon. The sale is to be made under the direction of Howard Taylor, who has been appointed by Judge Lacombe, of the United States Circuit Court, to act as special master to preside at the sale. Mr. Taylor in turn designated Mr. Day as his auctioneer.

The sale is a result of the foreclosure of the first consolidated mortgage of the Third Avenue Railroad Company, which was made on May 5, 1900.

The foreclosure sale of the property of the Forty-second Street, Manhattanville & St. Nicholas Avenue Railroad was postponed in an order signed by Judge Lacombe, of the United States Circuit Court. The date has been fixed as March 26. The sale had been set for February 1, and was postponed to March 1. The further postponement is due to the fact that the plans for reorganization are still pending and more time is needed.

Commission News from New York.

The Public Service Commission for the first district of the state of New York has, in the case of the Bronx Gas and Electric Company, granted approval of $643,000 of bonds. The company, in its application, asked for approval of an issue of bonds of par value of $1,500,000, secured by first mortgage. An immediate issue of $740,000 to retire $500,000 outstanding bonds was also asked. It was ordered by the commission that no part of the $580,000 par value of the bonds should be used for refunding the present issue of $500,000, unless $450,000 of the outstanding issue be cancelled and retired.

An order was also issued by the commission in the matter of the discontinuation of the passenger station upon the Kings County elevated line at Linwood Street, allowing the discontinuation and providing for the erection of a new station at Ashford Street. The proceeding which was brought to require an elevated station to be built by the Brooklyn Union Elevated Railroad Company was discontinued.

A complaint as to the present method of designating the routing of cars by colored lights, was made by the Public Safety Committee of New York city Federation of Women's Clubs and Rapid Transit Committee of One Hundred. The complainants held that the colored lights now displayed on the trains convey no information to strangers and are an inadequate method of indicating the destination of a train. They also requested that a suitable sign in the car should always indicate the name of the next station ahead.

The commission ordered that the Interborough Rapid Transit Company should not later than February 1, 1910, install on every car two destination signs similar to those now used, one sign to be placed at each end of each car at diagonal corners, and shall also so install and maintain two such destination signs on every new car put into operation. The order regarding maps was that the Interborough Rapid Transit Company should not later than February 1, 1910, install on every station, near each ticket office, a map showing the route of the railroad, with the stations and intersecting streets, plainly designated.

The Public Service Commission, second district, state of New York, has received a petition from the Niagara and Erie Power Company for authority to issue its stock and 1,250,000 five per cent thirty-year gold bonds. The authorized capital stock of the petitioner is $100,000. The company also asks for permission to have transferred to it certain property and franchises of the Niagara, Lockport and Ontario Power Company and the Buffalo & Lake Erie Traction Company, and for permission to begin construction and to exercise franchises.

Application has also been made by the Buffalo & Lake Erie Traction Company and the Niagara, Lockport and Ontario Power Company for consent to transfer to the Niagara and Erie Power Company certain capital stock, franchises and other property. The Niagara and Erie Power Company proposes to acquire, own and operate an electrical transmission and distributive system commencing at Gardenville, Erie County, and extending through the counties of Erie and Chautauqua, N. Y., and Erie County, Pa. It is stated in the petition that the Niagara, Lockport and Ontario Power Company and the Buffalo & Lake Erie Traction Company desire to transfer the property, contracts and franchises for the reason that the Niagara, Lockport and Ontario Power Company owns and operates two high-tension transmission lines from the Niagara River over private rights-of-way in the city of Syracuse and a large portion of the electrical current transmitted by it is sold and delivered to other electrical companies which sell and distribute same to the customer.

The character of service in the business of the Niagara, Lockport & Ontario Power Company renders it undesirable for that company to engage in distributing its current to the small consumer or in the operation of low-voltage distributing systems. It is deemed advisable that the Niagara, Lockport and Ontario Power Company should confine itself to the business of high-tension transmission of electric current and selling and delivering same in large blocks and should in no wise engage in low-voltage transmission of of electric current and retailing of the same.

The Public Service Commission, second district, state of New York, has authorized the Cliff Electrical Distributing Company, of Niagara Falls, to exercise rights, privileges and franchises acquired by the Niagara Falls Hydraulic Power and Manufacturing Company; also to increase its authorized capital stock from $25,000 to $500,000. The proceeds of the stock and bonds are to be used in payment for the transfer to it by the Hydraulic Power and Manufacturing Company of all the property rights and franchises referred to . The purchase price to be paid by the Cliff company is to be $750,000. The commission has also approved of the form of mortgage submitted by the Cliff company to secure the payment of its thirty-year five-percent gold bonds to the aggregate amount of $1,500,000. Provision is made in the order that nothing contained therein shall authorize the issue of any stock or bonds except as above mentioned, that all future or other issues of stock or bonds can be made only after the authorization of the commission.

This order provides for the segregation of the affairs of the Niagara Falls Hydraulic Power and Manufacturing Company so that such matters which relate to public service will be taken care of under the Cliff company organization and other matters not relating to public service shall continue to be administered by the Hydraulic Power and Manufacturing Company. Whatever rights the public had under the parent company are preserved under the Cliff company's authorization.

Sale of $5,500,000 McAdoo Notes.

To enable it to extend its tunnels up Sixth Avenue, from Twenty-third Street, Manhattan Borough, New York City, and to complete the line in Jersey City, the Hudson Companies have sold through Harvey Fisk & Sons $5,500,000 five per cent three-year notes to a syndicate, including J. P. Morgan & Company. The notes will be secured by bonds of the Hudson & Manhattan Railroad, $1,500 in bonds for every $1,000 of the notes. A similar issue was put out in January, 1908, when $15,000,000 six per cent notes were offered. Up to that date a total of $34,190,000 had been spent on construction. The new funds will enable the builders to complete the Hudson system of tunnels as originally planned, but do not provide for extending the line from Thirty-third Street and Sixth Avenue to the Grand Central Depot, as was the original intention.

The Faraday Society.

The forty-eighth ordinary meeting of the Faraday Society was held on Tuesday, January 18, 1910, at the Institution of Electrical Engineers, 92 Victoria Street, London, S. W., England. Dr. F. Mollwo Perkin, the treasurer of the Society, presided.

S. Field read a paper on "The Conditions which Determine the Composition of Electro-deposited Alloys."

Continuing the study of the quantitative composition of electro-deposited alloys, those of copper and silver have been examined. For the electrolyte, a mixture of the double cyanides was again used. Ordinarily silver is more negative than copper, but the difference in their character is such as would not seem to indicate any difficulty in depositing them simultaneously from a cyanide solution. The composition of the deposits was obtained by dissolving in nitric acid, and estimating the silver as chloride, except where the copper was obviously small, when that metal was determined.

When a copper coulometer is in circuit the ratio (R) of the weights of alloy and copper deposited in the coulometer gives a figure from which, under ideal conditions, the composition of the alloy may be determined thus:—Percentage of silver, 241 (R—2)/R.

Experiments soon proved that simultaneous deposition only occurs within very narrow limits. Thus when the metals in the solution are in the proportion of an even one equivalent of silver to thirty-four equivalents of copper no deposition of copper occurs under ordinary conditions of current density, but when in the proportion of one equivalent of silver to 100 equivalents of copper, simultaneous deposition proceeds more readily.

To examine the effect of such varying conditions as current density, free cyanide, and temperature, the following conditions were necessary: (1.) Large volume of solution, and, therefore, little change of composition during each experiment. (2.) Constant addition of silver to maintain a uniform content of that metal. (3.) Solution containing not more than 0.4 grain silver per litre. Under such conditions it was found that the percentage of the more positive copper decreases with rise of temperature of solution, and also with additions of free cyanide.

Thus the results follow the usual course as previously shown for brass, and the two metals become more widely separated in the presence of potassium cyanide. In no case were the deposits of any value physically, except where the silver very largely predominated.

A paper by Dr. F. Mollwo Perkin and W. E. Hughes, entitled, "Studies in the Electro-deposition of Metals," was read in abstract by Doctor Perkin.

The authors describe a rotating cathode employed for rapid electro-deposition of metals. It consists of sheet platinum spun up so as to form a narrow thimble, the upper end being open and having a stout iridium wire fused to it. This electrode, which has an active surface of 16.3 centimetres, is rapidly rotated within a cylindrical platinum gauze anode. In other cases, particularly when graded potential methods are employed, a spiral anode of platinum is rotated within the gauze cylinder, which then functions as cathode. In the potential measurements a cylindrical glass funnel with a glass tube sealed in the side is employed for holding the electrode.

Dr. Henry J. S. Sand, in a written communication, pointed out that the form of electrode ultimately found most suitable by the authors very nearly approached the one used by him, and if the investigation had been extended to this a further improvement would have been found. He considered the authors' electrodes were inferior in smallness of resistance to the electrolyte, stirring efficiency, and ease of manipulation. His electrodes, again, could be used with ordinary beakers and far less wash water was required. He had discarded the use of ammonium-nitrate solution as a connecting liquid, as on one occasion the auxiliary electrode gave completely wrong results.

Dr. F. M. Perkin, in reply, said the electrodes described in the paper were simpler and less costly than Doctor Sand's. He preferred the tap-funnels to beakers, and found no difficulty in raising the temperature of the electrolyte before pouring it into the funnel.

Method of Determining Maximum Demand.

In the report of the recent convention of the Wisconsin Electrical Association given in the January 29 issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, an error was made in connection with a system of maximum demand charges proposed by Wm. H. Winslow, of Superior, Wis. This error occurred at the top of page 241, where instead of "all over 500 watts at sixty-six and two-thirds per cent" the line line should read "all over 500 watts at sixteen and two-thirds per cent."

The two curves given here, show the method of fixing the maximum demand in both residences and stores. In the method of determining charges in resi-

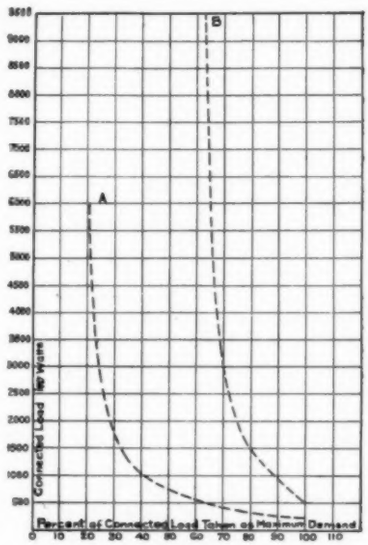


FIG. 1.

dences, shown by curve A, the assumption is made that the ratio between maximum demand and connected load decreases rapidly as the number of lamps installed increases. In fixing the charge for stores, shown in curve B, much the same method is used. Both curves would, of course, be largely modified by local conditions, such as the character of population, etc.

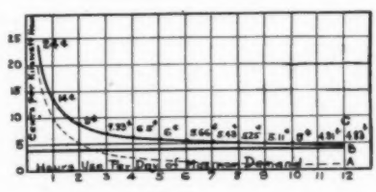


FIG. 2.

The curves A, B and C, Fig. 2, show the rate per kilowatt-hour for varying load factors, curve A representing rates at a fixed charge of fifteen cents per month for each fifty watts maximum demand, and curve B, the variable charge of four cents per kilowatt hour. Curve C which is the result of the addition of the other two curves, gives the rate charged in cents per kilowatt-hour.

Anaesthesia by Electricity.

A successful operation, in which the parts of the patient to be operated on were anaethetized by electricity, was performed by Dr. Marcus M. Johnson at the St. Francis's Hospital, Hartford, Conn., on January 25 last. Dr. Louise Rabinovitch managed the electrical end of the operation. Four toes, which had been frost-bitten, were successfully amputated, and the patient, whose name was not given by the surgeons in attendance, is said to have experienced no pain whatsoever while his toes were being cut off.

The electrodes were strapped to the legs near the knees, and when the current was turned on the legs were numbed below the knees just as if they had been cocainized.

Doctor Rabinovitch's plan consists of sending an interrupted current of electricity through the affected part of the human body to be operated upon. No other part is affected by the fluid. A current at fifty-four volts was used in this instance, reduced by means of a commutator to one-tenth of that amount. The interruptions of the current were estimated at 20,000 a minute. The secret of the use of the device is in correctly applying the electrode to the nerve that controls the affected part. Doctor Johnson said there were no bad after-effects, and the patient suffered no pain. He declared that the feat marked an epoch in anaesthetic surgery and that other forms of anaesthesia were likely to be entirely supplanted by Doctor Rabinovitch's process.

Columbia University Extends Its Sphere.

Announcement has been made of an important extension of the work of Columbia University, which will begin in September next. The new undertaking is an outgrowth of the success of the summer session of the University, which has been established for ten years, and which in 1909 attracted 2,000 students from all parts of the United States. It is now proposed to extend these principles so as to provide classes and laboratory work in the evening at the University, and both in the evening and during the day in other parts of New York city, as well as in northern New Jersey and Westchester County, for the benefit of those who are not able to avail themselves of the regular day courses.

The field to be covered by this extension teaching will be very broad. There will be classes organized in languages, literature, history, economics and politics; in various scientific subjects, including electrical and mechanical engineering; in architecture, including drafting and design; in music and fine arts; in preventive medicine and sanitary science; in manual training and the household arts; in teaching; and in law. The whole undertaking will be under the supervision of Prof. J. C. Egbert, who, as director of the summer session, has brought that branch of the University's activity to a high degree of excellence.

Requests for Columbia to enter upon work of this kind have been increasingly numerous during recent years. In particular, there is a demand that classes shall be organized in law for the benefit of the many students in northern New Jersey. The center of this institution will probably be at Newark. Classes in various branches of industrial chemistry and in electrical science will probably be organized in both Newark and Paterson.

It is expected that college instruction of the highest type will be offered in the evening in the city of New York, at a convenient downtown point, which can be reached from all parts of the city, as well as from Brooklyn and New Jersey.

New Pennsylvania Terminal Opens April 1.

April 1 has been formally decided upon by the Pennsylvania Railroad Company as the date for the opening of the new $100,000,000 terminal, the Manhattan, New York city, for Long Island traffic. The electric trains from the terminal to all points on the Island to which the third-rail system extends will run in and out of the Manhattan terminal and through the Erie Basin tubes from that date.

Trains under the North River will not be in operation until June 1 or later.

Fully 100,000,000 passengers can be handled in the new terminal each year —53,000,000 more than the Jersey City, Long Island City and Broad Street, Philadelphia, stations combined, handle in the same period. The Pennsylvania terminal will be able to receive and dispatch 145 trains an hour, which will amount to more than 1,000 for each day.

Railroads Would Enjoin Indiana Railroad Commission.

The Baltimore & Ohio, and six other prominent railroad companies have filed a series of suits in the United States and the State Courts attacking the validity of the act of the legislature creating the Railroad Commission of Indiana, and seeking to enjoin the commission from enforcing its recent order requiring the roads to equip its locomotives with 1,500-candlepower headlights. In addition to alleging that the title of the act is defective the companies claim that the business of the railroads is largely of an interstate nature and the Congress of the United States and not the State Legislature would have authority to regulate such matters. The companies assert that the brilliancy of the power-headlights of 1,500 candlepower causes the blinding of the enginemen, which frequently results in accidents because of their inability to distinguish the signal lights along the line. It is estimated that the carrying out of the commission's order will cost the roads $25,000 for lamps. The movement means extensive litigation. S.

Texas Interurban Projects.

A large number of interurban electric lines are projected in different parts of Texas. Most of them have for their territory the thickly populated sections around Dallas and Fort Worth. The plans for building such a line between Fort Worth and Mineral Wells, a distance of about fifty miles, are being matured by a syndicate composed of prominent citizens. The proposition is also indorsed by the Board of Trade of Fort Worth.

An international interurban electric railway is to be built to connect the City of Brownsville, Tex., with Matamoras, Mex. The new bridge, which is now being erected across the Rio Grande will be used to connect the two towns. The project is being promoted by B. G. Stegman of Brownsville and associates. They have applied to the City Council of Brownsville for a franchise to use the principal streets for the local railway system and to build a line to West Brownsville.

From an English source comes the information that direct telephone communication will probably be made between Paris, France, and Vienna, Austria, in the near future.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

PRESENTATION AND DISCUSSION OF W. L. CAMPBELL'S PAPER ON "MODERN AUTOMATIC TELEPHONE APPARATUS."

The 243rd meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building, New York city, on Friday evening, February 11. In the absence of President Stillwell, Secretary R. W. Pope called the meeting to order and made the announcement of new elections to the membership. As the meeting was held under the direct auspices of the committee on telegraphy and telephony, Mr. Pope called on William Maver, Jr., the chairman of this committee, to preside and conduct the meeting.

Chairman Maver said that while the question of automatic telephone exchanges is, perhaps, not a very burning one in the East, most telephone engineers know that such exchanges are in quite extensive operation in the western part of the country. However, New Bedford and Fall River, Mass., have automatic telephone exchanges which have been in operation successfully for eight or ten years. We have the pleasure of having before us a model exhibit of the Strowger automatic telephone exchange system, very kindly brought here by Mr. Campbell. During the reading of the paper, Mr. Campbell will make some experiments with the apparatus, showing the method of its operation, and subsequent to the reading of his paper, the subject will be thrown open for discussion.

W. Lee Campbell, of the Automatic Electric Company, Chicago, then presented his paper, entitled "Modern Automatic Telephone Apparatus," an extended abstract of which follows:

Although there are several different types of automatic telephone equipment upon the market or being developed, practically all of the working plants use apparatus of the Strowger type with or without the addition of Keith line switches. Since this paper must be confined to one system, only the one which is extensively used is discussed. The description will begin with a short reference to the subscriber's station equipment.

Prior to the year 1896, an automatic telephone subscriber called any number which he might desire by pressing push-buttons on his telephone. There were generally three push-buttons. If the subscriber wished to call No. 143, for example, he would first push the "hundreds" button once, then the "tens" button four times, and finally the "units" button three times. While this arrangement gave passable service, the subscribers made many mistakes in counting the pushes and sometimes did not press a button in far enough or hold it in long enough. Consequently, in 1896, a button-pushing machine or a "calling device," as it is commonly named, was substituted for the push-buttons. A modern desk telephone equipped with a calling device is shown in Fig. 1.

The visible portion of the calling device consists of a dial pivoted at its center so that it may be turned in a clockwise direction. For convenience in turning it has finger-holes, eleven in number, around its outer edge. Through each finger-hole, except the eleventh one, a number is seen. Thes numbers are consecutive from 1 to 9 and then 0. In automatic practice 0 always represents 10.

To call 143, for example, a subscriber will first put his finger into hole 1 and pull the dial around until his finger strikes the stop. He will then release the dial, place his finger in hole 4 and again pull the dial around until his finger strikes the stop. Finally he will place his finger in hole 3 and turn the dial till his finger again strikes the stop. He then places the receiver to his ear and awaits the answer of the party called. Each turn of the dial requires approximately one second, and by the time he has placed the receiver to his ear the automatic machines

FIG 1.—AUTOMATIC DESK TELEPHONE.

at central office will have completed the connection to the desired line and will be automatically ringing the bells of the desider telephone. When through talking, he hangs the receiver on the switchhook and the break in the talking circuit thus made causes the central office apparatus to return to normal condition.

There is contained within the calling device, but not seen, a revolving cam arranged to make and break the contact between a pair of springs. An escapement geared to a small governor controls the speed at which the cam revolves. The power is furnished by a clock-spring which is rewound each time the subscriber turns the dial. The cam does its work after subscriber's finger strikes the stop and while he is placing his finger in the next hole. If he tries to turn the dial before the cam rotation is finished, he finds it locked. It stays locked until the cam rotation is completed.

If the number called by a subscriber is "busy," his receiver will give forth an intermittent buzzing sound, the same as that used for a busy signal in large manual systems.

If the number he calls is that of a former subscriber, or of a subscriber whose number has been changed, he will be automatically switched to the information operator, who will give him the information most suitable under the circumstances.

If a "long-distance" connection is desired, the subscriber turns his dial once from the finger-hole 0, which is labeled "Long-Distance" also. He is thereby connected directly to the recording operator of the long-distance board, who takes his order just as in manual practice and then informs him that she will call him when she has his party.

Extension telephones, coin-in-the-slot telephones, party lines, inter-communicating systems, and private branch-exchanges are all worked satisfactorily at the subscriber's stations.

A subscriber's private branch switchboard may be either of the well-known manual type, presided over by an operator who makes the local connections and who supervises all of the calls to and from the public exchange, or it may be automatic with all subscribers' stations equipped with automatic telephones so that they may call each other or call public exchange patrons by means of their automatic calling devices without the aid of an operator, or it may be a combination of the two with the local calls automatic and those to and from the public exchange supervised.

The transmitter, receiver, ringer, and hook-switch for an automatic telephone may be of any standard type. The only part of the instrument that is peculiar to the automatic system is the calling device. In fact an ordinary common-battery manual telephone may readily be adapted for automatic service by mounting the calling device upon it.

Turning from the discussion of the subscriber's station to the central office equipment, the machines which make the connections between subscribers' lines are divided into the following classes: 1.—Line switches. 2.—Selector switches. 3.—Connector switches.

A connector switch, commonly called a "connector," is the last one operated in completing each connection; but as its functions correspond most closely to those of an operator on a manual switchboard it will be considered first.

There are two principal differences between the work of an operator on a multiple switchboard and that of an automatic connector. The first lies in the difference in the number of lines to which they have access. The operator has within her reach a multiple jack for every line in the switchboard, be the number of lines 1,000 or 10,000. She may therefore make a connection to any line entering the office, but a connector switch has access to but 100 lines. Secondly, a subscriber's operator takes the orders of and makes connections for certain predetermined subscribers only. The number she serves seldom exceeds 200 and is often less than 100, but a connector switch is, when idle, ready to handle the order of any subscriber who may wish to connect to any one of the 100 lines to which it has access.

The lower part of the connector-switch machine supports two curved banks of contact plates or strips. The under bank, called the link bank, contains 100 pairs of these contact plates arranged in ten horizontal rows, ten pairs to the row These pairs of bank contacts correspond to the line springs in the multiple jacks of a manual board, and may be multipled before any desired number of connector switches. The upper bank contains 100 single contacts which correspond to the rings of multiple jacks. This is the busy-test bank, commonly called the "private" bank. The cord and plug of the manual board are represented by the "wipers" on the shaft of the machine. The lower, or line wiper, consists of a pair of long flexible springs insulated from each other and each soldered to a flexible cord, while the upper, or private wiper, is a pair of springs connected together to a third cord. The movements of

the wipers, corresponding to those of an operator raising a plug and inserting it into the proper multiple jack, are performed by the shaft which has a step-by-step vertical movement and a step-by-step rotary movement. These movements are actuated by pawls and ratchets operated by electromagnets controlled by the subscriber from the calling device on his telephone, and are always in accordance with the last two digits of the number he calls. For example, if he calls a number ending in 43, the shaft is raised four steps and then rotated three steps, thus raising each wiper opposite the fourth row of contacts from the bottom of its respective bank and then sliding it over to the third contact in the row. The machine is then ready to close the circuit of the calling subscriber through to the circuit of the called party, but before doing this it first closes the private wiper-circuit only and thus makes an automatic busy test. If it finds the desired line busy, it keeps the connection open and immediately transmits the busy signal back to the calling subscriber. If the desired line is not engaged, the connector switch immediately begins to ring the called party's telephone bell automatically and intermittently. When he answers, the ringing stops and the two subscribers' lines are closed together for conversation. Talking current is supplied to the transmitters of both telephones from the central office battery through the relay coils of this connector switch, just as in manual practice it is supplied through the relay coils of the cord circuit. The talking circuit includes nothing but these coils and the subscribers' stations.

When the subscriber's conversation is completed and the calling party restores his receiver to the switch-hook, the shaft of this connector switch is "released" and is immediately returned to normal position by means of a clock-spring and gravity. It is now ready to handle another connection for any subscriber in the plant.

One such switch cannot, of course, handle all calls to the 100 lines to which it has access. In the average plant, ten connectors are sufficient, however, for each 100 lines, because ordinarily not more than ten subscribers in any hundred are ever receiving calls simultaneously. Consequently a system of 10,000 lines, for example, is divided into 100 groups of 100 lines each, the calls to the subscribers in each group being completed by a set or multiple of ten connector switches. Where it is found necessary, more than ten connectors may be put in a multiple; where expedient, economy is attained by putting in less than ten. Uniformity is desirable, however, and it is therefore good practice—although it is not general practice—to exercise some care in arranging the subscribers' numbers, so that each group of 100 will contain approximately the same proportion of frequently used lines to lines that are used less often. The grouping of lines is strictly according to number; that is, all lines numbered from 2,100 to 2,199 are put into one group and connected to by one set of connectors, while all lines from 2,200 to 2,299 are put into another group, etc. It will now be understood that a calling party, to complete a connection to a desired line, must first obtain connection to an idle connector switch belonging to the group or multiple, in which the desired line terminates. In other words, processes of group selection and of idle switch selection are performed by other switches which do their work before the connector switch is operated.

These switches, which are called selector switches, have already been mentioned. A selector switch looks, and is, very much like a connector switch; in fact the mechanism and banks are the same. The differences are in the circuits and relays only. In a system of 10,000 lines, these selectors are divided into two classes; namely, first selectors and second selectors. While there is a group of connector switches for each 100 lines to which connections are to be made, there is a group or multiple of second selectors for each 1,000 lines to which connections are to be made, and a group or multiple of first selectors for each 10,000 lines to which connections are to be made. The bank contacts of the selector switches are terminals of trunk lines, instead of subscribers' lines. The first or lower row of first-selector bank contacts constitutes the terminals for a group of ten trunk lines leading to second-selector switches in the 1,000 section of the plant. The second row represents another group of ten trunk lines to second selectors in the 2,000 section of the plant, the third row represents a group of trunks leading to second selectors in the 3,000 section of the plant, etc., so that through the ten rows of bank contacts the first selector has access to ten second selectors in each of the ten sections of 1,000 lines which make up a 10,000-line office. The first-selector switch used by a calling subscriber is operated in accordance with the first digit of the number he calls. Suppose, for example, he is calling the number 2,543. The impulse sent in by the first movement of his calling device will raise the shaft, and accordingly the wipers of the first-selector switch two steps, placing each wiper opposite the row of bank contacts second from the bottom in its respective bank. Now the selector switch, unlike a connector switch, does not wait for the subscriber to make another turn of his dial before rotating its shaft, but the rotation is automatic and beyond the subscriber's control. The rotation starts the instant the vertical movement is completed, and, in the particular case which is here used as an example, sweeps the wipers step-by-step over the row of bank contacts connected to trunks leading to the 2,000 section. At each step of the rotation the bank contacts on which the wipers then rest are given the busy test, and as soon as a disengaged trunk line is found the rotary movement stops and the connection is completed to an idle second selector.

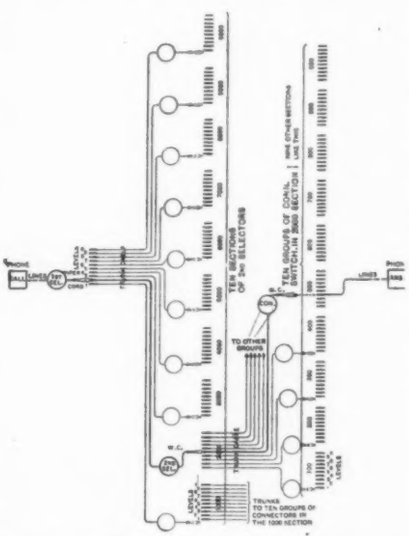


FIG. 2.—SIMPLE DIAGRAM OF AUTOMATIC TELEPHONE SYSTEM.

This is all accomplished in a fraction of a second, so that the second selector is operated by the subscriber's calling device impulses corresponding to the second digit, 5, of the number 2,543 which he is calling. The wipers of the second selector are accordingly raised five steps and are then automatically rotated just as the first-selector wipers were. The bank contacts of this second selector are the terminals of the trunks to the ten sets of connectors which complete the connections to the line groups making up the 2,000 section of the plant. Consequently when the second-selector wipers stop on an idle trunk in the fifth multiple, the calling subscriber is placed in connection with an idle connector in the 2,500 groups; that is, a connector which has access to the desired subscriber's line, No. 2,543. This connector is then operated by the last two movements of the subscriber's calling device, and performs the functions of an operator in the manner already described.

Fig. 2 is an endeavor to illustrate this grouping arrangement and shows the connection just described from the calling telephone to a first selector, then from the second row of first-selector bank contacts to a second selector in the 2,000 section of the exchange, then from the fifth level of this second selector's bank contacts to a connector switch in the 500 group of the 2,000 section, and then through the fourth row of the bank contacts of this connector to the called telephone.

It is readily understood that by thus using a first selector to pick out a trunk to any one of ten different 1,000 sections, second selectors in each section to pick out trunks to any 100 group in each 1,000, and then by using the connectors to complete calls to individual lines in each 100, that connection may be made by the use of three switches from any calling telephone to any number from 0000 to 9,999, or in other words to 10,000 different numbers. It will also be readily understood that by using a fourth switch, called a third-selector switch, and using numbers with five digits instead of four, that the capacity of the system will be multiplied by ten and will be 100,000 lines instead of 10,000. In a system of 100,000 lines, 10,000 numbers are generally set aside for each main central office. Consequently on each call the first selector picks a trunk to the desired office, the second selector picks a trunk to the desired 1,000 in that office, the third selector picks a trunk to the desired 100 and the connector completes the connection to the desired line.

In all 100,000-line systems the numbers are made up of a letter and four figures instead of five figures. Using this arrangement, 26,187, for example, would appear in the telephone directory as B-6187. When operating the calling device many subscribers will remember a letter and four figures more clearly than they will five figures.

It might be inferred from the foregoing portion of this paper that there is one first-selector switch permanently connected to every subscriber's line. Formerly this was the case, but in a modern plant each line terminates in a much smaller and a cheaper device called a line switch. The line switch is not under the control of the subscriber, but connects him automatically to an idle first-selector switch the instant he removes his receiver from his switch-hook preparatory to making a call. The first-selector is, therefore, operated by the first impulses transmitted from the subscriber's calling device just as in the older systems. When the line switches are used, ten first-selectors for each 100 lines are generally sufficient to handle the traffic.

Each line switch includes the line and cut-off relays with which each line is equipped just as in manual practice. It also includes a movable plunger arm at the end of which a plunger is so pivoted that it may be swung back and forth over the line-switch bank. The bank consists of ten sets of springs and represents a multiple of ten trunks to first-selector switches. The line switches are mounted in groups of twenty-five each on the face of an upright in such a manner that the plungers are in alinement. The notch in the head of each plunger meshes with a rocking bar or "master shaft" as it is called. A step-by-step device, called a master switch, is connected to each pair or

to each four master-shafts and by means of them can swing the plungers back and forth, step-by-step over the banks of contact springs. Normally the plungers are at rest poised over bank contacts multipled to an idle trunk.

When a subscriber removes his receiver from his telephone switch-hook preparatory to making a call, a circuit is thereby closed which causes the plunger arm of his line switch to be instantly pulled down, carrying its plunger out of engagement with the master-shaft and thrusting it into the bank. The effect of this is to connect the subscriber's line to a trunk leading to an idle first-selector switch.

The instant that one line switch thrusts its plunger into the bank, thus occupying the trunk over whose multiple all idle plungers have been poised, the master-switch operates and swings the remaining idle plungers forward over the next multiple of bank contacts. If this trunk should be busy, the movement proceeds until an idle trunk is found. It is to be noted that a line switch always uses a pre-selected idle trunk instead of making a selection after a subscriber starts to call, as the Strowger selector switches do. This is quite an important feature and saves considerable time in establishing a connection.

Ordinarily the banks of 100 line switches are multipled together and connected to ten first-selector trunks, but for four-party line service or extra heavy traffic, the number in one multiple is often reduced to fifty. A regular complete line-switch unit is mounted with 100 line switches and two master-switches. Only one master-switch is used at a time, the other being held in reserve. The ten connector switches used for handling calls incoming to any 100 lines are mounted on the same upright as the line switches handling their outgoing calls.

While the primary object of the line switches was to reduce the cost of the switchboard by eliminating ninety per cent of the comparatively expensive first-selector switches, they have also simplified the central office equipment and have reduced the space required for it. Further, they have resulted in several new and somewhat radical departures in the art of building automatic telephone systems. The most important of these is the line-switch district station which enables very considerable savings to be made in underground and aerial cable.

A district station is installed by placing one or more line-switch units complete with connector switches in a small building at the telephonic center of a district, generally a mile or more distant from the nearest central office. The lines of all telephones in the district are brought to the district station and are there connected to the line switches. The first selectors to which these line switches are trunked remain at the nearest large central office, consequently when a district-station subscriber removes his receiver from his switch-hook preparatory to making a call, his line switch instantly puts him into connection by means of a trunk with a first-selector switch at central office. The connector switches for handling the calls to the district-station telephones are mounted in their usual places on the back of the line-switch units, and are connected by trunks to the banks of second selectors, also located at the nearest central office. Thus all calls from and to the district are handled over trunks instead of over subscribers' lines.

Since, as already stated, there are usually but ten first selectors and ten connectors for each 100 lines, and since but three pairs are needed for testing and supervisory circuits to the district station, a total of twenty-three trunk pairs is sufficient between the station and the central office. This leaves a net saving of seventy-seven pairs of wires per 100 lines. In district-station practice stations of less than 500 subscribers are generally unattended and supervised entirely from the central office to which they connect. This is so thoroughly worked out that the wire-chief can test every line entering each district station without leaving his desk at central. Stations of 500 lines or more are generally put into a combination residence and office building so that one attendant living in the building gives the equipment all the attention that it may require at any time.

A typical line-switch district station building 15 by 16 feet has a capacity of 700 lines.

There is a notable system in Columbus, Ohio, using one large central office of approximately 10,000 lines, surrounded by nine district stations, varying in size from 100 to 600 lines. One of these 100-line units in Columbus was installed as an experiment in an underground vault about the size of an ordinary underground manhole, and has now been so operating for about two years.

One can readily imagine that the trunking scheme of this system would be very complicated if each of the small offices had trunks to each of the other offices. Furthermore the cost of trunks divided into such small groups would be so much greater, that the saving in line wires would be much reduced and in some instances almost wiped out. But using the district stations each having trunks to no office except the central office (placed near the business center of the city) the trunking plan is a very simple and economical one, and the conditions for centralized supervision of the system are practically ideal.

A new feature called a secondary line-switch has very recently been introduced into the automatic system. The mechanical construction of this switch and of its bank is the same as that of the regular or primary line-switch, and it is mounted and controlled by a master-switch in the same manner. The purpose of the switch is still further to reduce the required number of first-selector switches, and their trunks. As explained, it has been the general practice to install a number of first selectors equal to ten per cent of the number of subscribers' lines. Observations made in numerous plants at the busiest hour of the day, however, show that at the peak of the load not more than from one and five-tenths to five per cent of the subscribers are using first selectors. The percetage is smaller in the

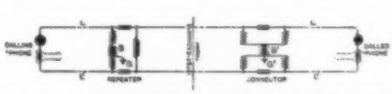


FIG 3.—INTER-OFFICE TALKING CIRCUIT.

larger plants and greater in the smaller plants, being about five per cent for a plant of 1,000 lines and not over two per cent for a plant of 10,000 lines. This reduction in the percentage of trunks required as the number of subscribers' lines increases, follows a law well known among telephone engineers. The secondary line-switch takes advantage of this principle by making it practicable to give 2,000 or 2,500 subscribers' lines access to one group of 100 first selectors. The secondary switches are inserted between the line-switches and the first selectors in such a way that the primary line-switches pre-select idle secondaries and the secondaries pre-select idle first selectors. Therefore, when a subscriber lifts his receiver from the switch-hook preparatory to making a call, his line-switch and the secondary to which it connects him operate almost in unison. This re-selection of trunks, combined with a rather complex system of cross-multipling, accomplishes the desired result of giving a large number of subscribers access to one group of trunks, and thereby reduces the number of trunks and first selectors. It is obvious that if the selectors are at a considerable distance from the line-switches, for example, in a central office while the primary and secondary line-switches are in a district station, that these secondary switches will save materially in the cost of trunks to the first selectors.

Inter-office trunks in automatic systems are equipped with another piece of apparatus, which is called a repeater. This is simply a set of relays, and derives its name from the fact that it repeats the calling-device impulses from the subscriber's line to the trunk. It serves another important purpose, for through its relay coils, talking current is supplied to the transmitter of the calling subscriber.

Talking current is always supplied to the called subscriber's telephone through the connector switch used in calling him. Such an inter-office talking circuit is shown diagrammatically in Fig. 3. Each subscriber always receives talking current from the office in which his line terminates. This is in conformity with the best practice which requires that the subscriber's "loops" shall be as short as possible, and as nearly alike in resistance as conditions will allow. This makes it practicable to supply all transmitters with sufficient current through small and economical line wires, and to supply them all with comparatively the same amount of current.

There are just two measures of permanent success for any telephone apparatus. One is its popularity with its users and the other is the profits it affords the owners. Numerous investigations, some of them made on a very large scale have, to the best of the writer's knowledge, always resulted in the verdict that automatic telephone service is preferred to manual service by the large majority of telephone users, and while the first cost of the equipment is greater than that of manual equipment, the elimination of operators' wages, the saving in building space, and the savings in cable and conduit have generally made automatic equipment a more profitable investment than manual equipment.

While a considerable number of small private automatic plants are in use, public automatic systems are generally confined to cities and the larger towns. For where a manual switchboard is so small that during a considerable portion of the day one operator can make all local connections and, in addition, handle all rural and long-distance calls, it is very difficult and generally impossible for an automatic switch to compete with it. The larger the system the more economical automatic apparatus becomes. It is a matter of common engineering knowledge that automatic machinery is not warranted in any class of work until the output desired becomes sufficiently larger.

When automatic machinery is substituted for manual labor it is generally for three purposes: 1—to increase and quicken production; 2—to reduce the cost of the product; 3—to secure uniformity both in the quality or form of the product and in the time required to make it.

These results have been generally attained by automatic machine telephone switchboards. Almost every one likes to feel that the making and breaking of each connection is entirely in his own control. The quickness with which connections are obtained appeals to the subscribers, and in relation to this it is to be noted that while connections are generally obtained more quickly than in manual service, the instantaneous disconnection is another good feature which is appreciated by any one who has occasion to call several numbers in rapid succession. Bankers, doctors, and others, who have private matters to discuss over the telephone wire, appreciate the comparative secrecy of the system. The uniformity of the service at all hours of the day or night, holidays and Sundays included, is attractive to many.

Although inventors have been giving attention to automatic switchboards as long as to manual switchboards, and although automatic equipment has passed through as many stages of development, and in many instances through stages of development similar to those through which the manual apparatus has passed, yet the former has not by any means reached the dead level of "no more beyond" that the latter has. From one view point this is discouraging, but on the whole it is inspiring, for while those who are most familiar with automatic equipment are most painfully aware that it has not yet been brought to its highest possible state of development, they are, at the same time, its most enthusiastic admirers, and they hope, by further development, simplification, and reductions in first cost, that many families who cannot now afford telephone service of any kind will have it offered to them at a price which they can pay and that the telephone will thus eventually become a universal household necessity.

They also hope that the automatic operation of many long-distance lines will greatly increase their capacity and consequent efficiency. This has been tried on a small scale between Columbus and Dayton, Ohio, with very encouraging results. Inasmuch as both of these cities are equipped with automatic switchboards for local service, it was only necessary to have a toll line terminate in the automatic switchboard in one city and in a calling device before a long-distance operator in the other city to make a trial. It was found that connections could be put up much quicker than in the ordinary way. This plan is used very satisfactorily by several automatic companies for handling their own short local toll lines, by giving the operator at each suburban town a calling-device, and allowing her to call all parties in the city automatically without any supervision at the city end of the line. While the opportunity for an operator cheating the company by not reporting all fees earned and collected is greater than with double checking, this has not been found to be a serious drawback. In fact, it is possible to bridge an ordinary stock ticker across the line in such a way that it records every call the operator makes and the length of every conversation. It has been found, however, that the knowledge that this could be done, and might be secretly done at any time, has been sufficient to prevent any tendency toward dishonesty. Careful tests and comparisons made by one company using a considerable number of these short automatic toll lines showed that sufficiently busy lines handled three times the number of conversations that was possible with the former arrangement.

Secretary R. W. Pope, in opening the discussion of the paper, expressed his gratification on seeing the modest claims made by its author, and that he has refrained from saying that the automatic system will answer in every place and under all conditions. In a certain sense Mr. Pope was quite familiar with the system, for he happened to be chairman of the committee on telegraphy and signaling at the World's Fair in Chicago in 1893, and remembered examining the Strowger system that was on exhibition at that time. It did not receive an award because of its crude condition, and it was felt that it was not equal to the claims made for it then. It seemed to be the opinion that it was better adapted for the smaller cities, and the question of its suitability for the larger cities had not been proven. Since that time it has been proven. Last summer, when Secretary Pope visited the Pacific coast, he had the opportunity of examining the automatic system in operation in Portland, Ore. It was rather a novel experience to be in that exchange of about 8,000 lines and see the connections, or rather hear them, being made throughout the room with practically no one in attendance at all. He learned there from Institute members, who were simply subscribers to the automatic system, that from their experience they preferred the automatic system to the manual system on account of its certainty of conveying the signals, and not giving the wrong numbers. Occasionally a lineman came looking for trouble on their circuits before they knew that there was any trouble. It appears that instead of waiting for trouble to be reported from the outside, the men can locate the trouble on the line from the exchange and remove it promptly before the subscriber is aware of it. Another interesting device which was called to his attention was the meter for registering the calls. In some of the cities on the Coast the franchise requires that in the telephone exchange system the subscriber must pay by the number of calls. The result is that they are obliged to meter the system, and that meter registers only the perfect calls; it discards "service" calls and discards calls that are not completed, so that the meter actually registers only the calls that are to be paid for. This is an important feature of the system. From Portland, Secretary Pope went to San Francisco, and there the Home Telephone Company's system was in process of construction. He visited the main exchange and several of the branches, and it was quite evident that the people who are building that system had faith in the automatic telephone equipment, because it was one of the best and most expensively constructed systems that he had ever visited. No expense had been saved to make the installation first-class in every particular. It must be remembered that the manual system may be properly divided into two classes, so far as the subscriber is concerned—the subscriber may work direct with the exchange or he may work through a private branch exchange. In the course of Mr. Pope's experience he has come to believe that the perfection of the manual system depends very largely on the disposition, the voice and the attention of the particular operator that has charge of the section with which one is connected. With the introduction of a private branch the operator usually has less on her mind, and we therefore do not receive the short and petulant answers and the impression that we are trespassing on the time of somebody that we get when we are connected with the main exchange.

Chairman Maver remarked that Mr. Campbell is quite modest in his claims and presents his apparatus about as though it were on trial, whereas it is in actual operation on a large scale in over fifty cities and towns in this country, embracing a total of 250,000 subscribers. Mr. Maver recalled his experience with some early experiments with the Callendar automatic telephone, which was in limited use for some time in several cities, and contrasted these early efforts with the automatic system of today. One of the most frequent objections that was directed against automatic telephony in its early days was that the multiplicity of contacts would prevent its successful operation, and it used to be pointed out that whereas in a manual exchange for 5,000 subscribers there are something like 133,000 contacts, in a corresponding automatic exchange there are several times as many pairs of contacts in the selectors and connectors. The introduction of the Keith line switch, however, has reduced the number of such contacts in the automatic exchange by nearly ninety per cent. Even, however, before the introduction of the Keith switch, comparatively little trouble was experienced by the great multiplicity of contacts in the automatic exchange; and from actual observation such troubles are quickly indicated by supervisory signals. Another point is that the wear and tear on the automatic apparatus is inconsiderable. This is partly due to the fact that much of the apparatus is not in operation from ninety-five to ninety-eight per cent of the time. Apart from this, actual experiments with certain automatic apparatus, where the mechanism was operated by machinery over one million times, showed that the wear of the parts was not perceptible.

E. A. Mellinger, of Chicago, had submitted a communication in which he pointed out that since a very large pro-

portion of the telephones in use in the country are in exchanges of 500 lines or less, the development of a simple inexpensive switchboard designed especially for use in the small town exchange would go far toward making the telephone universal. Concerning the economic disadvantages of small automatic exchanges, it would be of interest to know how large an exchange must be to justify the use of automatic equipment as now installed, and what factors are to be considered in making a comparison. A consideration of the data available from a number of both manual and automatic exchanges indicates that the automatic begins to show economy at about 500 lines.

E. L. Lehman, of Camden, N. J., also submitted a communication, in which he asked a number of questions concerning what he regarded as the shortcomings of the automatic system. In the manual switchboard any trouble occurring with the "busy" or "trouble back" signals would be noticed instantly a connection was put up. "Don't answer" reports are given to the calling subscriber, if the called subscriber does not answer. In the case of the calling subscriber insisting that the called subscriber is within hearing of his telephone a report of "can't raise" is given to the wire chief who makes a test on the line and quite often finds the line in trouble, in which case repairs may be quickly made. Mr. Lehman asked how the automatic system could notify subscribers who left receivers off the hook.

H. W. Pope, of the American Telephone and Telegraph Company, said he had an idea that the cost of maintenance is a very large one in the automatic system. It probably requires a skilled man for every 1,000 telephones, which is quite an item in a large exchange. A good system, whether manual or automatic, should be one that is available for all people, for the illiterate and for the blind, or any person that can speak the language of the country in which the telephone system is operated. How can one handle this automatic system in the dark, unless one is very familiar with the apparatus? This is quite an essential thing, so far as its use in residences is concerned. In case of danger, fire, burglary, or anything of that kind, the mere fact of taking the telephone off the hook calls attention in the manual system to the fact that something is the matter. From what he had learned and seen, Mr. Pope had always considered the automatic an expensive system to maintain; but he did find that it gives great satisfaction to the subscribers, and it eliminates a good deal of difficulty in connection with the wrong number, as it comes back to the subscriber every time.

Charles A. LeQuesne, Jr., Parker H. Kemble and J. H. Shearer also briefly discussed the question, after which Mr. Campbell closed the discussion by calling attention to the fact that the method of taking care of an automatic system is somewhat different from that usually pursued with a manually operated switchboard. The "trouble" reports that are commonly used for recording trouble with automatic telephone switchboards divide the troubles into two classes—detected troubles and reported troubles. If the switchboard attendant does not put down more detected troubles than reported troubles, it is generally taken for granted by his supervisor that he is not giving very close attention to his duty. An automatic switchboard is provided with supervisory signals for the use of the attendant, but many of the disorders he notices simply by the sound of the machines. An experienced automatic switchboard man who is anywhere within hearing of an automatic switchboard will tell instantly if there is a machine which is not working properly. If he should fail to notice it, there is always a complaint clerk and an information operator at central to whom the subscriber can report his trouble, just as is customary with the manual plant. If a subscriber leaves his receiver off the hook, his attention is called to it in the same way that it is in the case of the manual plant. There is a device called a "howler" connected to his line, which sends an alternating current of high-frequency and considerable voltage through his receiver, and this calls the subscriber's attention to the fact that his receiver is left off the hook. In regard to trunks and private branch exchange switchboards, these are handled in a manner similiar to that in use in manual practice. For instance, any subscriber desiring connection with a private branch exchange having, say, six trunks with the same number simply calls the number shown in the directory and, if the first trunk is busy, he is automatically switched to the second trunk, and so on until he finds an idle trunk. The apparatus does automatically what the operator does on the manual switchboard. If all the trunks are busy, the calling party gets the "busy" signal just as he does in manual practice. As to the cost of maintenance, the maintenance labor for the automatic system is undoubtedly higher than for the manual system. The cost of maintenance material, however, for the automatic system is considerably less. According to Mr. Campbell's recollection, the cost of new cords alone on the manual system will more than pay for the cost of all the maintenance materials on an automatic system of the same size. The additional cost of maintenance labor on the automatic system is considerably more than offset by the elimination of the operators' wages, and the latter also takes care of the higher charges on the automatic system, due to its greater first cost. With regard to the method of reporting fires with the automatic system, nearly every automatic system in operation is arranged so that the subscriber by making one turn of his dial can report the fire to the attendant at the central office. This attendant throws on and simultaneously rings all of the fire alarm stations, or as many as the authorities desire to have rung, and reports the fire. It is very common in cities where the automatic systems are in use to have fire alarms sent in from the automatic switchboards. It may be that the party, on whose premises the fire is, is sometimes too excited to be able to report it, but he had never heard of such a case. With reference to pay stations, there are very few pay stations in operation in connection with automatic systems, and in fact very few pay stations in operation in any independent telephone system. The pay station with an automatic system is operated in this way—the subscriber removes his receiver from the switchhook and calls the party he wants in the usual manner. If the party answers he then drops his coin. Until he drops the coin he cannot talk to the called party. He can hear the called party answer him. As soon as he drops the coin, his own switch is closed and he proceeds with the conversation. If he wants "long distance" or "trouble operator" or some one to whom he should have free service, the apparatus is arranged so that it is not necessary for him to drop a coin in order to close the talking circuit.

THE DESIGN OF CONSTANT POTENTIAL TRANSFORMERS.[1]

BY W. T. RYAN.

PART II—METHOD OF DESIGN.

A transformer is usually designed to take current from the mains at a prescribed electromotive force and frequency, and to deliver current to a receiving circuit at a different prescribed electromotive force.

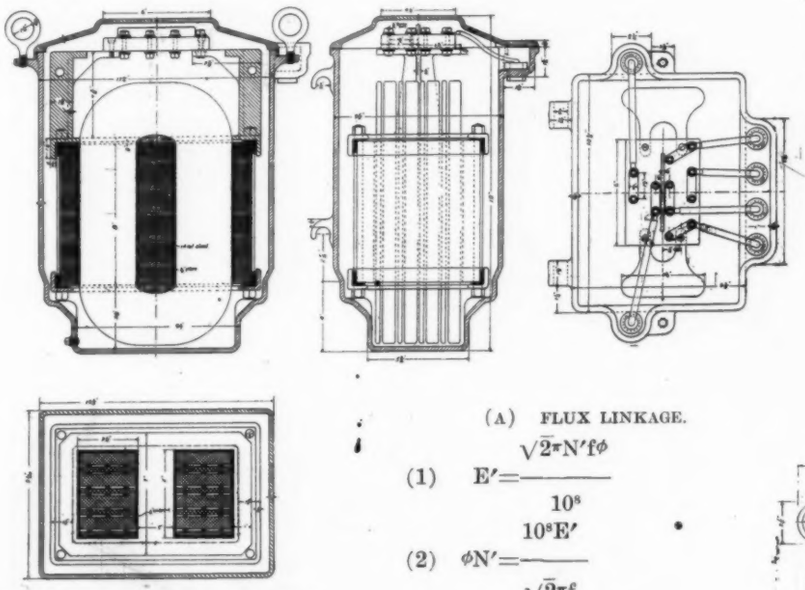


FIG. 15.—SHELL TYPE TRANSFORMER.

In the designing of such a transformer there is but one condition which must be met precisely, namely, the ratio of primary to secondary turns must be equal to the ratio between the prescribed primary and secondary voltages. All other points in the design are to a large extent matters of choice guided in a general way by experience.

In designing a transformer the principal points to strive for are: 1, good insulation; 2, good regulation; 3, high efficiency; 4, small open-circuit current; 5, small rise in temperature; 6, low first cost.

Some of these conditions are opposed to others, as for example good regulation and good insulation. The allowable temperature rise varies widely with different makers, also the extent of radiating surface required per watt loss per degree rise of temperature varies between extremely wide limits, hence no simple rule can be given governing the matter.

Given the required output of a transformer (rated output which can be satisfactorily delivered to a non-inductive circuit), frequency, primary and secondary electromotive force, the design of the transformer may be determined as follows:

(A) FLUX LINKAGE.

$$(1)\quad E' = \frac{\sqrt{2}\pi N' f \phi}{10^8}$$

$$(2)\quad \phi N' = \frac{10^8 E'}{\sqrt{2}\pi f} = \frac{22{,}510{,}000\ E'}{f}$$

Where,

ϕ =maximum magnetic flux.
f =frequency in cycles per second.
N′ =number of turns in primary.
E′ =primary electromotive force.
$\phi N'$=flux linkages.

(B) FLUX AND NUMBER OF TURNS.

Either the flux or the number of turns must be assumed. The first assumption will probably give a poorly proportioned design. If so, new assumptions must be made and the design revised, until finally the proper proportions are obtained. This requires both judgment and patience.

Table I gives fair values for the total fluxes of distributed coil lighting and power transformers. Table II gives a similar set of values for the distributed magnetic circuit type. Both tables are based on a frequency of sixty cycles per second. From equation (2) it is seen at once that if the frequency is lower the flux must be correspondingly larger.

TABLE I.
Distributed Coil Type

Capacity in Kilowatts	Flux in Maxwells
1	180,000
2	240,000
5	400,000
10	600,000
15	720,000
20	840,000
25	900,000
30	950,000
40	1,000,000
50	1,050,000
60	1,100,000
75	1,150,000
100	1,200,000

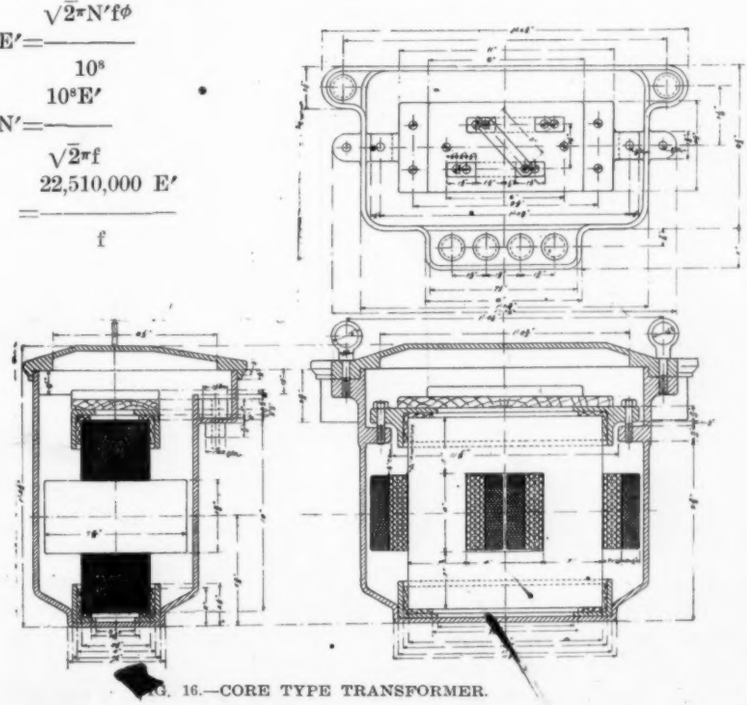


FIG. 16.—CORE TYPE TRANSFORMER.

TABLE II.
Distributed Magnetic Circuit Type

Capacity in Kilowatts	Flux in Maxwells
1	300,000
2	400,000
5	680,000
10	1,000,000
15	1,200,000
20	1,400,000
25	1,500,000
30	1,600,000
40	1,670,000
50	1,725,000
60	1,775,000
75	1,825,000
100	1,900,000

1—The first part of this article appeared in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, February 5, 1910.

$$(3)\quad N'' = \frac{N'}{r}$$

Where,

N'' = number of secondary turns,

r = ratio of transformation.

(C) AREA OF MAGNETIC CIRCUIT.

$$(4)\quad A_m = \frac{\phi}{(.9)\ (\beta)}$$

Where A_m = area magnetic circuit,

β = flux density.

An allowance of ten per cent is made for the insulation between the iron laminations making up the core.

For twenty-five cycle transformers assume a flux density of from 65,000 to 95,000 lines of force per square inch; for sixty-cycle transformers from 45,000 to 65,000 lines per square inch; for 125-cycle transformers from 35,000 to 50,000 lines per square inch.

If the magnetic circuit is distributed, A_m is the total area of the magnetic circuits. The different magnetic circuits are in parallel and each is of the same area and length, thus having equal reluctance.

There are various methods of procedure from this point on. In the method about to be outlined by the author the iron loss is assumed. From the guaranteed efficiencies of various manufacturers one can easily pre-determine this loss very closely. In the modern transformer the leakage is so small that the copper loss practically determines the regulation on non-inductive loads. The core loss and copper loss practically determine the efficiency. Hence, if the efficiency on a non-inductive load and the regulation are guaranteed, the core loss can be very closely estimated. If the regulation of a well designed transformer is one per cent and the efficiency is ninety-eight per cent on a non-inductive load, the core loss will be slightly more than one per cent (100—98—1=1) of the capacity of the transformer. The core loss obtained by this method will be found to be about ten per cent low in sizes below fifty kilowatt and five per cent low for sizes above 100 kilowatt.

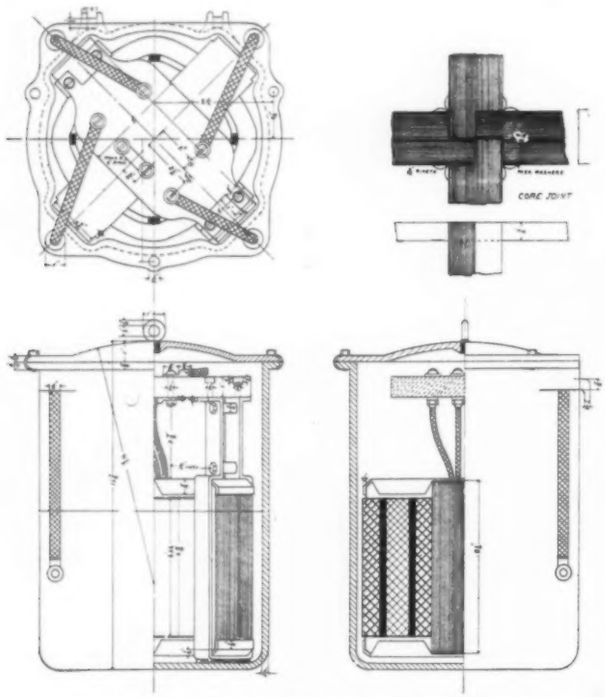


FIG. 17.—DOUBLE SHELL TYPE TRANSFORMER.

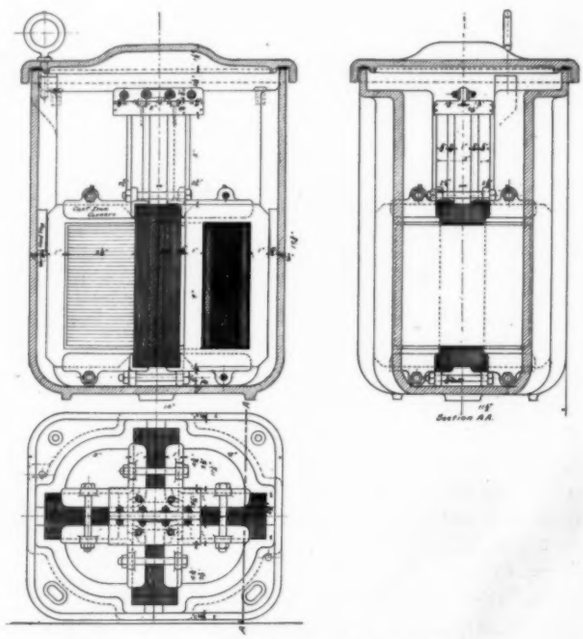


FIG. 18.—DOUBLE SHELL TYPE TRANSFORMER.

Then again in the handbooks and in several of the manufacturing companies' bulletins may be found tables giving the actual iron losses of various sized transformers up to fifty kilowatt capacity.

(D) VOLUME OF IRON.

$$(5)\quad W_h = \frac{\eta\, f\, V\, \beta^{1.6}}{10^7} \quad \text{(Steinmetz)}$$

$$(6)\quad W_e = \frac{1.645\, d^2\, f^2\, \beta^2\, V}{10^{11}} \quad \text{(Steinmetz)}$$

$$(7)\quad W_c = W_h + W_e$$

$$(8)\quad W_c = \frac{\eta\, f\, V\, \beta^{1.6}}{10^7} + \frac{1.645\, d^2\, f^2\, \beta^2\, V}{10^{11}}$$

$$= \frac{Vf\,(10^4\, \eta\, \beta^{1.6} + 1.645\, d^2\, f\, \beta^2)}{10^{11}}$$

$$(9)\quad V = \frac{10^{11}\, W_c}{f\,(10^4\, \eta\, \beta^{1.6} + 1.645\, d^2\, f\, \beta^2)}$$

Where W_h = hysteresis loss in watts,

W_e = eddy current loss in watts,

W_c = total core loss in watts,

V = volume of iron in cubic centimetres,

f = frequency in cycles per second,

η = coefficient of hysteresis,

β = number of lines of force per square centimetre,

d = thickness of iron laminations in centimetres.

0.0015 is a fair value for η. The thickness of iron laminations used in most transformers is fourteen mils, that is 0.014 inch.

(E) LENGTH OF MAGNETIC CIRCUIT.

$$(10)\quad L_m = \frac{V}{A_m}$$

Where L_m = length of magnetic circuit in centimetres,

A_m = area of magnetic circuit in square centimetres,

V = volume of magnetic circuit in cubic centimetres.

If the magnetic circuit is distributed, L_m will be the length of each one of the parallel circuits.

(F) AREA OF CONDUCTORS.

In a well ventilated transformer it is usually necessary to provide 1,000 to 1,200 circular mils per ampere in the high-tension winding and from 1,200 to 1,500 circular mils per ampere in the low-tension winding.

$$(11)\quad I' = \frac{\text{Watt Capacity}}{E'}$$

Where I' = primary current (for purpose of design)
E' = primary electromotive force.

$$(12)\quad I'' = \frac{\text{Watt Capacity}}{E''}$$

Where I'' = secondary current,
E'' = secondary electromotive force.

(G) SPACE OCCUPIED BY CORE AND WINDINGS.

Lay out a magnetic circuit on the drawing board which will have approximately the predetermined area and volume and which will accommodate the windings in the space which is available. A good idea of the relative dimensions of the magnetic circuit may be obtained by examining Figs. 15 to 21 inclusive. In determining the space occupied by the coils proper allowance must be made for insulation and for ventilating ducts.

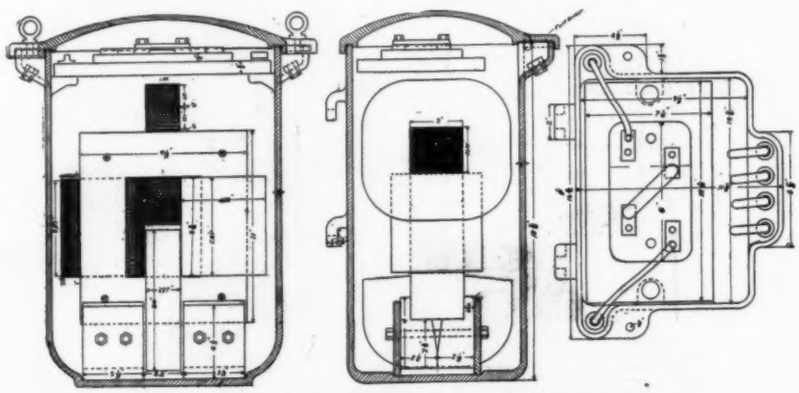


FIG. 19.—DISTRIBUTED COIL TYPE TRANSFORMER.

(H) NUMBER OF SECONDARY TURNS.

$$(13)\quad N'' = \frac{N'\,E''}{E'}$$

Where N'' = number of secondary turns,
N' = number of primary turns,
E'' = secondary electromotive force,
E' = primary electromotive force.

The primary and secondary coils should be split up into at least two coils to allow connecting in series or multiple for different circuits.

(I) WEIGHT AND RESISTANCE OF CONDUCTOR.

The average length per turn and the total length and total weight of copper in each coil may now be readily determined.

(J) LOSSES.

The copper loss in the primary may be obtained by the equation:

$$(14)\quad W' = (I')^2\,R'$$

Where W' = copper loss in primary,
I' = primary current,
R' = resistance of primary.

The copper loss in the secondary will be similarly:

$$(15)\quad W'' = (I'')^2\,R''$$

Where W'' = copper loss in the secondary,
I'' = secondary current,
R'' = resistance of secondary.

The hysteresis and eddy current losses may be obtained by formulas (5) and (6). These losses will of course be as expected, since the basis of the design in the beginning was the amount of these losses.

(K) LEAKAGE FLUX.

This question has been treated by several authors. Sheldon and Mason present the problem very clearly and concisely in their last textbook on alternating current machines.

(L) REGULATION.

Sheldon and Mason, Foster, the authors of the "Standard Handbook for Electrical Engineers," and several other writers have covered this problem.

(M) NO-LOAD PRIMARY CURRENT.

The no-load primary current, I'_o, is the resultant of the iron loss component, I'_w, and the magnetizing component, I'_m.

$$(16)\quad I'_o = \sqrt{(I'_m)^2 + (I'_w)^2}$$

$$(17)\quad I'_w = \frac{W_c}{E'}$$

Where W_c = core loss in watts.

$$(18)\quad I_m' = \frac{10\,L_m\,\phi}{4\pi\,N'\,A\,\mu\,\sqrt{2}} = \frac{.5627\,\beta\,L_m}{N'\,\mu}$$

Where β = flux density,
L_m = length of magnetic circuit,
N' = primary turns,
μ = permeability of magnetic circuit at density β.

In order to determine the primary current at various loads, I'_w is added directly to I' and I'_m to I' at right angles; I' being the current which would flow in the primary if the efficiency were 100 per cent.

The no-load primary current is exceedingly small in a well designed transformer, hence the error made by obtaining the primary current by dividing the watt capacity by the primary electromotive force is entirely negligible.

(N) EFFICIENCY.

The efficiency for non-inductive load is given by the formula:

$$(19)\quad \text{Efficiency} = \frac{E''\,I''}{E''\,I'' + 1'^2\,R' + I''^2 R'' + W_c}$$

The all-day efficiency is usually calculated on the basis of full load for five hours and no load for nineteen hours. It is thus given by the formula.

$$(20)\quad \text{Efficiency} = \frac{5E''\,I''}{5(E''I'' + I'^2R' + I''^2R'') + 24W_c}$$

(O) CASE.

In designing a case the principal points to keep in mind are, strength for handling, provision for securing coils in position, accessibility for inspection and repairs, proper insulation of leads where they pass through the case and large radiating surface with small weight. There should be provided approximately three square inches of radiating surface per watt of loss for oil-cooled transformers and six for air-cooled transformers. In the larger sizes it will be found necessary to corrugate the case in order to obtain sufficient radiating surface.

The accompanying illustrations are made from some transformer designs worked out by senior students in electrical engineering under the guidance of the author and applying the principles laid down above. The first five of the designs, Figs. 15 to 19 are for transformers of the same rating, transformation ratio and frequency, but of different types; these data are: capacity, five kilowatts; ratio, 2,200/220 and 1,100/110; frequency, sixty cycles.

Fig. No.	15		16		17		18		19		20	
Type	Shell		Core		Double shell		Double shell		Distributed coil		Welding	
Windings	L. T.	H. T.	L. T.	H. T.	L. T.	H. T.	L. T.	H. T.	L. T.	H. T.	L. T.	H. T.
No. of coils	4	4	2	2	2	1	2	2	4	4	4	4
Turns per coil	48	480	92	920	103	2060	99	990	54	540	1	30
Total turns	192	1920	184	1840	206	2060	198	1980	216	2160	4	120
Size of wire	.18x.18	No. 15	No. 5	No. 17	No. 5	No.14	.10x.188	No. 16	$\frac{1}{16}$x$\frac{1}{16}$	No. 15	castings	ribbon
Length of wire (feet)	528	5280	230	3110	352	3520	130	3842	262	3388	....	295
Weight of copper (pounds)	117.5		63		79		60		67		139	
Weight of iron core	46.5		73		45		64		51		208	
Total weight of transformer	410		...		224		....		193		....	
Copper loss, full load (watts)	97.5		102		127		93.5		117		138	
Hysteresis loss	54.5		65		69		54		58		115	
Eddy current loss	17.5		19		23		16		17		43	
Full-load efficiency	96.8		96.6		96.6		96.8		96.2		96.1	
All-day efficiency	91.8		...		...		92.2		91.2		...	

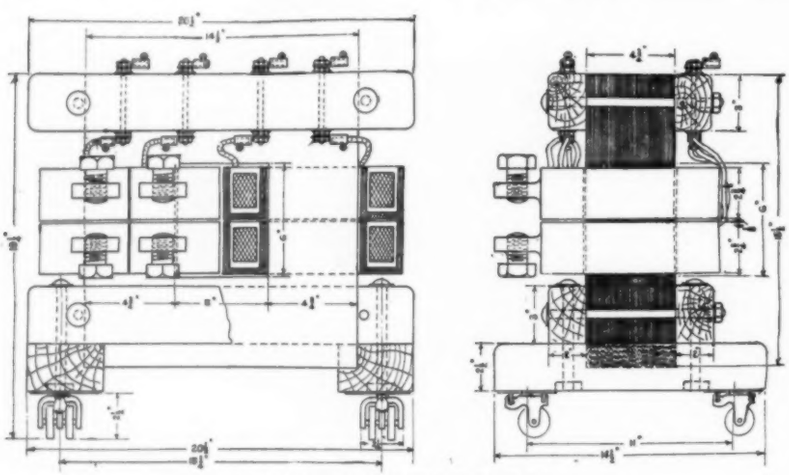


FIG. 20.—WELDING TRANSFORMER.

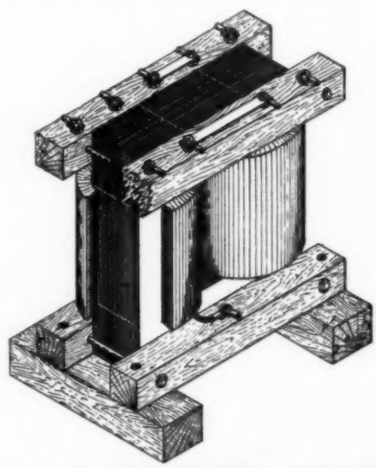


FIG. 21.—TRANSFORMER FOR LABORATORY USE.

Fig. 20 shows a seven-kilowatt welding transformer designed and built for use in the electrical laboratory of the University of Minnesota. It is intended for a voltage ratio of 170/5.5 at thirty cycles and 115/7.6 at sixty cycles.

The principal data for these six transformers not given above are found in the accompanying table.

Fig. 21 shows a four-kilowatt transformer designed and built by students in the electrical engineering department of the University of Minnesota. The ratio of transformation is one to one. The voltage may be 110 or 220. Ten-volt taps and Scott connections are provided. These transformers are mounted on ball-bearing castors and are placed in the laboratory for the elementary transformer tests. They make an excellent type for this class of work.

The Oxidation of Atmospheric Nitrogen.

Profs. F. Haber and A. Koenig publish a very complete review of the work done in this field from the middle of 1907 to the middle of 1909. The several processes for the production of nitric acid from the atmosphere at present in commercial operation in Europe are briefly described in the first chapter of the review.

The second chapter contains a review of scientific investigations carried out regarding the burning of air in electric discharges, especially for the purpose of explaining the mechanism of this process. Brief reviews of all important lectures and publications on the subject, with indication of the original sources of information, are given in the third chapter. The fourth and last is devoted to a review of patents, European and American, issued during the period mentioned. The patents are subdivided into various classes, namely those relating to the production of nitrous gases without electricity, burning of air by means of electric discharges or arcs, productions of the arcs, cooling of the gases, electrodes, special arrangements, and the working up of the gases.—*Abstracted from Zeitschrift für Elektrochemie, January 1, 1910.*

Machinery Men to Meet at Jacksonville, Florida

A joint committee of the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association is to be held in Jacksonville, Fla., April 5, 6 and 7, 1910. Headquarters for both associations will be at the Hotel Seminole. Arrangements for the technical and entertainment programmes are being rapidly perfected. Those intending to be present should notify F. D. Mitchell, secretary-treasurer of the American association, as soon as possible so that identification badges may be made out.

Application has been made for reduced railroad rates under the certificate plan. It has been suggested that following adjournment of the convention a number of the members of both associations may wish to make a trip through Florida, and then on to Cuba, provided arrangements can be made to have the tickets extended. Those desiring this privilege should notify Alvin M. Smith, secretary and treasurer Southern Supply and Machinery Dealers' Association, Richmond, Va., who will endeavor to make the arrangements, should a sufficient number of applications be received.

TELEPHONY—TELEGRAPHY, and WIRELESS.

SUBMARINE TELEPHONE CIRCUITS ACROSS SAN FRANCISCO BAY.

BY SAMUEL G. M'MEEN.

San Francisco is on a peninsula, but a large part of its business population crosses about five miles of sea-water morning and evening. The cities of Oakland, Berkeley, and Alameda, Cal., are on the mainland and are related to the financial, trade and professional life of San Francisco in much the same way that Brooklyn and the New Jersey communities are related to the intense center of Manhattan.

DIAGRAM SHOWING THE PATH OF THE TELEPHONE CABLE FROM SAN FRANCISCO TO OAKLAND, CAL.

In both San Francisco, and Oakland, automatic telephone systems are in operation and are growing rapidly. Similar systems are under construction in other parts of the general community about San Francisco Bay. In order to provide communication between the automatic telephones on the mainland and those on the peninsula, a submarine telephone cable was laid in San Francisco Bay on December 9, 1909.

This cable contains fifty pairs of No. 19 B. & S. gauge wires with double paper insulation, and is of low mutual capacity. The lead sheath is covered by a jute bed of a mean depth of five-thirty-seconds of an inch. Upon this jute bed is laid an armor composed of twenty-six No. 6 B. W. G. galvanized steel wires. The cable so armored is finally covered by a jute serving, treated outside with tar, sand and lime.

The cable has a weight of 7.5 pounds per lineal foot and an outside diameter of 2.3 inches.

The general object of providing communication between the telephone subscribers on the mainland and on the peninsula is to be accomplished by means of this cable, and others like it to be laid in San Francisco Bay hereafter. The trunk circuits of which the submarine cable forms a part extend between the principal switching office in San Francisco and the principal switching office in Oakland. Systems of trunks which interconnect the various offices of the two general regions enable any subscriber on the mainland to be connected with any subscriber on the peninsula.

The distance by the wire route between the San Francisco and Oakland switching offices is about 8.3 miles. Of this distance, about 4.8 miles is by water and the balance is by land. From the mainland shore, however, a railway mole extends somewhat over a mile into the Bay, towards San Francisco. The underground conduit system of the Oakland exchange is carried westward to the end of this mole, enabling underground trunk cables of large gauge to pass to within 3.7 miles of the San Francisco shore. The latter distance is spanned by means of the submarine cable under description.

The submarine cable core was manufactured on the Atlantic Coast. The lead sheath was applied in Oakland. The armoring was done in San Francisco. It was delivered, after armoring, in lengths of three thousand feet or less, each such length being on a single reel, seven lengths being required to make up the total. The seven lengths were spliced into a single length, being reeled, as spliced, upon a special reel designed to be driven by power while carried on a barge. Power was furnished by means of a steam donkey engine. The power connection with the reel is such as to enable the reel to be run forward in taking up cable as it is spliced and to be run backward in reeling off for laying. A substantial brake enables the reel to be stopped. The general form of the large reel can be seen in the accompanying photograph and some of its general dimensions are as follows: Diameter of shaft, eleven inches; distance between heads, sixteen feet; diameter of drum, six feet, three and one-half inches; winding depth below teeth, two feet; total weight of empty reel, 26.5 tons.

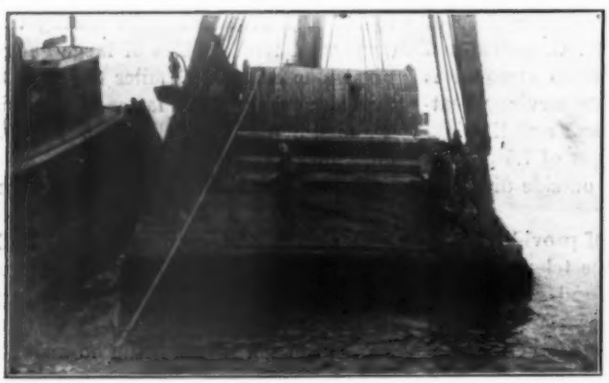
CABLE BARGE PASSING GOAT ISLAND, SAN FRANCISCO BAY.

These dimensions are such as to enable the reel to carry considerably more than one hundred tons of submarine cable of the general type described herein, or about 5.3 miles.

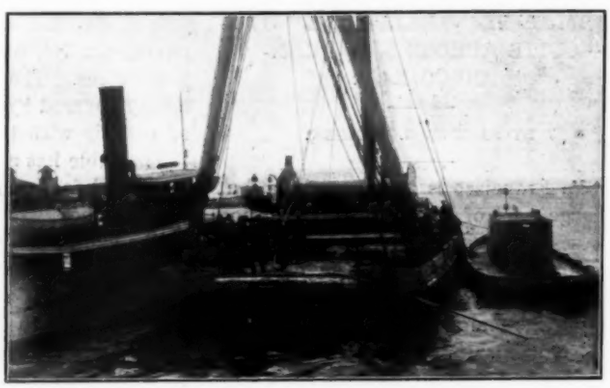
A railway wharf extends westward

from the western end of the railway mole along which the trunk cable has been described as being underground. As it is probable that the requirements of the future will eliminate this railway wharf, the submarine cable passes under the wharf and makes a slight detour to reach the end of the mole. A region of much probable future dredging is avoided in this way, including the region in which an additional ferry slip will be erected at the western end of the mole.

These conditions required the laying of the cable in two sections, the first run being from the San Francisco shore to the railway wharf and the second run being from the end of the mole westward to the end of the first section. Both runs were made as planned and the cable spliced below the railway wharf and dropped to the bottom of the bay.



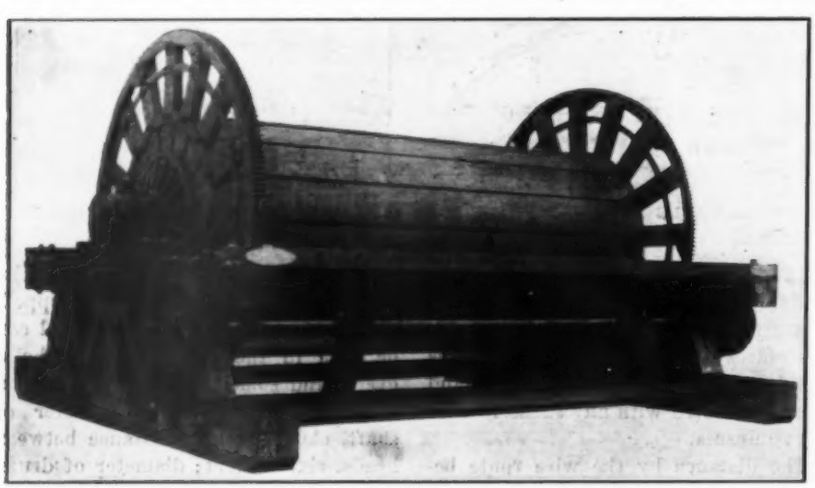
LEAVING THE SAN FRANCISCO SHORE.



AT THE END OF THE FIRST RUN.

The barge carrying the cable reel was moved by two sea-going tugs, one lashed alongside of the barge and the other pulling ahead by a hawser. The problem of navigation required allowance for both wind and tide, in a period of one hour and fifteen minutes of laying the first length of over 17,500 feet. The point at which the first length theoretically should end and the original single length should be cut for the splice under the railway wharf had been identified at the outset in splicing the cable. In the actual laying, the cable was cut at exactly this point, indicating that the allowances for depth and for wind and tide were correct.

The cable lies entirely within the area in which anchorage of vessels is forbidden by the United States Government. The maximum depth is thirteen fathoms. The bottom is of fine gray sand, black mud, or broken shale. There is no tidal flow great enough to move the cable, at this part of the bay and there are no prominent rocks.



POWER-DRIVEN CABLE-REEL—CAPACITY 105 TONS OF CABLE.

Wireless Station at Porto Bello.

The first message from the new wireless station at Porto Bello, Canal Zone, Panama, was received at the Colon station on December 31, addressed to Major B. H. Fuller, the commandant at Camp Elliott, says the *Canal Record*, and announced that the service had been opened by a temporary arrangement of the wires. Since that date, a large amount of business for the Isthmian Canal Commission, and especially for the Atlantic Division, has been transacted regularly through the Colon station, distant about seventeen miles.

The plant is completed, with the exception of the mast, which is partly erected, and the rigging of the 520-foot circle aerial. With two wires working from the highest point, it has been possible to hear the stations at Key West, Guantanamo, and Bluefields, although an interchange of communications between those points and Porto Bello has been precluded so far, on account of the incomplete aerial installation.

The station is equipped with an improved type of DeForest apparatus, including a duplicate set of tuners, which not only furnishes an instrument in reserve, but also permits the transmission of messages from both instruments at the same time, providing the radius in which one operator is working, is outside the radius of the other.

Electrical power is supplied by the commission plant at Porto Bello, and the station ground is secured by means of sixteen copper plates, each three by six feet in size, sunk in the bed of the Porto Bello reservoir near by.

The plant is in charge of Chief Electrician W. R. McDonald, U. S. Navy, who was detailed for service at Porto Bello from the flagship Connecticut of the Atlantic fleet, and is served by three operators. All four men are quartered in the building.

INTERESTING TELEPHONE TESTIMONY.

THE VICE-PRESIDENT OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY GIVES A CANDID ACCOUNT OF THE PROPOSED PURCHASE OF TELEPHONE PROPERTIES THAT WAS ABANDONED—OTHERS APPEAR AND ANSWER INQUIRIES.

Edward J. Hall, vice-president of the American Telephone and Telegraph Company, was examined last week in New York city before John F. O'Neill as special commissioner in connection with suits instituted in Ohio by minority stockholders of telephone companies, who wanted to know about the recent acquisition by J. P. Morgan & Company, bankers of New York city, of a controlling interest in these companies.

The stockholders are endeavoring to show that Mr. Morgan was acting as an agent of the Bell interests. The testimony so far indicates that the purchase was made by the Morgan interests, independent of the American Telephone and Telegraph Company, as an investment proposition.

Eight independent telephone companies operating in the leading cities of Ohio and Indiana were sold last autumn to R. L. Day & Company, New York brokers. On December 8, Day & Company sold them to J. P. Morgan & Company, who said in a letter to the attorney-general of Ohio that the purchase was for their own account and operation.

The hearing was held in the Mutual Life Building, New York, and from the testimony of Mr. Hall it appeared that the Bell company had had many opportunities of buying in the smaller companies within the past seven or eight years, and that the purchase of the Ohio companies had been favorably considered last fall; but when the Standard Oil decision was made public it frightened investors from entering into the plan drawn up by the Bell company, and the proposed purchase was not made.

Mr. Hall, on the witness stand, said:

"About the middle of October last I received word that F. H. Goff, president of the Cleveland Trust Company, had a large amount of stock for sale and wished to know whether I was interested. I arranged for a conference here in New York.

"Mr. Goff said he represented Mr. Everett and associates, who held a large amount of stock in the United States and Cuyahoga Telephone companies which they desired to sell. He had an option which was about expiring, and it was necessary to have an answer quickly.

"I recommended the purchase to President Vail and the executive committee, composed of Senator W. Murray Crane, John I. Waterbury, Henry S. Howe and Mr. Vail. The company's counsel, Mr. Leverett and Mr. Thatcher, were doubtful, however, whether it could be legally done. They desired time to investigate.

"As it was necessary to give an answer to Mr. Goff one way or the other, suggestion was made that some banking house might be requested to make the purchase and hold the properties for us pending the investigation. R. L. Day & Company were mentioned and I sent for W. H. Remick of that firm.

"Mr. Remick expressed willingness to go ahead, provided proper arrangements were made to protect his firm. A contract was drawn up which provided that we should furnish the money and that they would agree not to dispose of the securities until a reasonable opportunity had been afforded us to purchase at the same price.

"We loaned them something over $7,000,000 on that contract.

"On account of the decision in the Standard Oil case we were unable to get any banker to take an interest in a holding company plan. They would simply throw up their hands on mention of a holding company and exclaim, 'Impossible.' They said that the instant you spoke of holding companies to investors they would have nothing to do with it.

"I first approached R. L. Day & Company with the proposition that they form a syndicate. Then I went to Moffat & White. After they both declined I took it up with J. P. Morgan & Company, who also declined. So then on February 8 we notified R. L. Day & Company that we would not purchase the properties and that they were at liberty to sell elsewhere. The first knowledge I had of the sale to J. P. Morgan & Company was gained from the newspaper accounts. I had no knowledge of any negotiations between them. The American company did not participate in any way in the transactions between Day & Company and Morgan & Company.

"Our advances to R. L. Day & Company were repaid."

F. G. Nelson, assistant treasurer of the American Telephone and Telegraph Company, said that he thought he remembered receiving the $7,000,000 check drawn by the Knickerbocker Trust Company in connection with the repayment by Day & Company on December 9. He did remember receiving a $280,000 check on December 10. These made the sum of $7,280,000 advanced. He also received, on December 29, a check for $33,620 for interest. Counsel endeavored to make a point of witness' "thinking" he received the $7,000,000 check. But when George B. Leverett, who with Thomas Thatcher represented the American Telephone and Telegraph Company, as counsel, brought out the fact that the company had a daily balance of $13,000,000 Mr. McGraw said that he supposed, after all, under such conditions a mere $7,000,000 amounted to only a row of pins.

Mr. McGraw referred to testimony that had been introduced to show that after Day & Company began buying into the independent companies the rate of tolls between Columbus and Cleveland by the United States company's lines had been increased from thirty-five cents to sixty cents, while the Bell company rate remained at thirty-five cents, with the implication that the controlling company wished thereby to discourage use of independent lines. But Mr. Hall said, when asked about this, that he knew nothing about it; he did know that the Bell company's rate had not been increased.

A dispatch from Lexington, Ky., on February 9, and confirmed in Cincinnati by George B. Cox, indicates that the Morgan interests are making large investments in independent telephone companies in Kentucky. John M. Lassing has secured an interest in the Home Telephone Company at Lexington and has a large block of stock, if not a controlling interest, in the Louisville Home Telephone Company, and he is said to be acting for George B. Cox, of Cincinnati, who is supposed to represent the Morgan syndicate. It is the belief in financial circles that the idea is to consolidate all the independent companies in the Ohio Valley.

William H. Remick, resident partner

in New York of the banking firm of R. L. Day & Company, was a witness later in the hearing.

Mr. Remick's testimony brought out, among other things, that after he had the independent companies in his hands he retained William H. Baker, formerly general manager of the Mackay companies, to look after them.

The question of a sale to Morgan & Company, said Mr. Remick, came up through a telephone message which he received from H. P. Davison, of that firm, about December 7, asking for an appointment. Mr. Remick went over to the Morgan office.

"What was said?" asked the counsel for the complainants.

"Mr. Davison said he understood that I had telephone securities and asked if I wanted to sell them. I said that I had such securities subject to an option and that if the option were released I should be very glad to sell them."

Mr. Remick told how he went up to the American Telephone and Telegraph Company's offices and got the option released, after which he returned to Morgan & Company and informed Mr. Davison, who requested a memorandum of the securities. This was subsequently furnished and the sale was completed of such of the telephone securities bought by the Day firm as had been delivered up to that time, with the exception of the stock and bonds of the Huntington Mutual Telephone Company, of Huntington, W. Va.

Asked who had bought the Huntington company, Mr. Remick replied that all he remembered then was that a New Jersey senator had bought it. He could not recall the name. Counsel for the complainants asked if Mr. Remick were sure that it wasn't a Massachusetts senator, referring to the fact that W. Murray Crane is a director of the American Telephone and Telegraph Company. Mr. Remick insisted that it was a Jerseyman, and subsequent access to his records showed that that individual was Edmund W. Wakelee, a member of the New Jersey state senate.

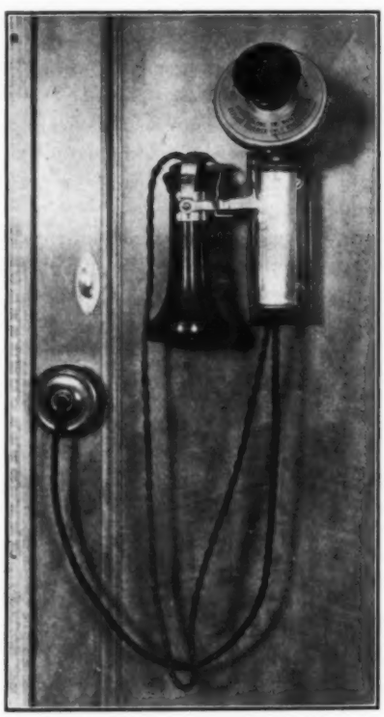
The hearing will continue Thursday of this week in New York city, when Theodore N. Vail, president of the American Telephone and Telegraph Company, and Mr. Davison will be examined. All of the witnesses are appearing voluntarily, and counsel for the telephone combination asked the visitors if they wanted Mr. Morgan on the stand. A definite answer will not be made until Mr. Davison has been examined.

One of the lawyers in the case said after the hearing that Mr. Morgan's first and last information came through a conversation with Mr. Davison in a taxicab. Mr. Davison explained that he was considering the purchase of some telephone securities.

"All right," Mr. Morgan is reported to have said, "go ahead. I want to go to dinner."

Telephone Equipment in the Royal Stateroom of the Lusitania.

On the Cunard liner, Lusitania, the royal stateroom is provided with a special telephone equipment, shown in the accompanying illustration. The body of the telephone is of metal silvered to harmonize with the furnishings and general color scheme of the room decoration. The bell, induction coil, and condenser are mounted in a neat box having a white enameled cover and the bell boxes are completely out of sight, the wiring between them and the instruments being run behind the paneling of the cabin.



ROYAL STATEROOM TELEPHONE SET ON THE STEAMSHIP LUSITANIA.

It may be stated that the switch hook is designed to grip the receiver and prevent the latter from falling down or knocking against the side of the instrument when the ship rolls. That part of the switch hook which holds the receiver is also pivoted horizontally so that the receiver may swing with the ship and always tend to maintain the active length of the lever.

It is held that if this provision had not been made, the swing of the ship would lift the lever owing to the shortening of the distance between the center of gravity of the receiver and the fulcrum of the lever. On account of the highly satisfactory working of this arrangement it is believed that it will become universal for this class of service on ship board.

Chicago Subway Company's Plans.

Until the experts who are at present investigating the property of the Chicago Subway Company with a view to determining the best action to be taken have submitted their report, it is probable that no reorganization plan will be made.

At the present time the telephone end of the company is receiving more attention than other branches. A new central switchboard is to be installed which will have approximately 20,000 connections. The franchise of the company makes the completion of the telephone within the next several months imperative.

There is no disposition on the part of the officials of the tunnel branch to push operations. They are satisfied to take care of permanent freight contracts until a definite plan is worked out, after which additional receiving stations will be constructed and new equipment installed.

In the event of the proposed Chicago passenger traction subways being built over the Illinois Tunnel it is likely that the tunnel company will be forced to add greatly to its capacity in order to take care of the transportation requirements which will result from the construction work on the passenger subway. It is quite probable that the tunnel company will get this business which will add greatly to its income.

As to the disposition of new financing of the Chicago Subway Company, little can be said at the present time.

Brooklyn Edison's Addition.

The Edison Electric Illuminating Company, of Brooklyn, intends to erect a $2,500,000 addition to its present Pearl Street plant.

CENTRAL-STATION PRACTICE

Transmission—Interior Wiring

THE ELECTRIC VEHICLE SITUATION IN NEW ENGLAND.

BY FRANK J. STONE.

Somewhat over a year ago the situation in New England as to electric vehicles was anything but inspiring. Prospects were scarce, inquiries rare. Even the central station, to whom it meant so much, was an unconscionable skeptic. Selling electrics was the next thing to, if not wholly, a begging proposition.

Explanations of this unwarranted apathy have been often given, and I think that the strongest argument is that the manufacturer in early days did not give sufficient importance to the proper application of the machine and sufficient attention to its operation after being turned over to the customer, both of which policies are vital.

In November, 1908, a prominent storage-battery manufacturing company gave a lecture on the care and operation of batteries before a large audience in Boston. There were present prominent vehicle manufacturers, transportation engineers, central-station men and merchants. It was the means of exciting a great deal of interest. At the same time this concern also started an electric-vehicle campaign, and expended a vast amount of money and energy in the work, concentrating its efforts on the central station, and urging the co-operation of the latter in building up the electric-vehicle business. This was the direct cause of a number of central stations advocating the use of the electric and also advertising the sale of current for electric vehicles. As a result numerous inquiries for electric vehicles were turned in to the battery company, which in turn distributed them to the vehicle manufacturers, requesting them to follow them up. The results of this work are plainly in evidence.

A few months later on an organization was formed known as "The Electric Vehicle and Central Station Association," the object of which was to promote the use of the electric vehicle. This organization was made up of prominent electric-vehicle manufacturers, electrical manufacturers and central-station men, forming a triple alliance, and a campaign of education was commenced which has also proven effective. The association holds monthly meetings which are well attended by members and interested prospective purchasers. The illustrated lectures have been published monthly in the press medium of the association as well as in other prominent journals, and a fund of very valuable information on this subject has been gathered and distributed.

The selling organizations of the vehicle manufacturers have been strengthened, new agencies have been opened up, and the representatives in the majority of cases, on the commercial end especially, have been working, so to speak, eighteen hours a day.

There are now six electric garages in Boston alone, where a year ago there were but two, and the electric vehicle on the streets of Boston is a very common sight. There were estimated to be about 140 electric vehicles in operation in Boston and vicinity a year ago, and it is safe to say that the number has now more than doubled.

The central stations have, in many cases, awakened to the enormous possibilities of the electric-vehicle load and now have electrics in operation on their own systems.

In a previous paper I submitted a table showing a comparison of the electric vehicle load with that of the arc and incandescent lamp and the flatiron. I think this will bear repeating, and I take the liberty of submitting it here.

	Arc Lamp	Incandescent Lamp	Flatiron
1 Pleasure vehicle equals..	2.4	107	20
1 Professional or business runabout	6	267	51
1 Light commercial vehicle	9	400	75
1 Heavier " "	14	640	123
1 Heaviest " "	21	933	179

These figures speak for themselves. The table was made up from actual central-station and electric-vehicle experience, taking into consideration the use of the 550-watt arc lamp operating on an average of four hours per day, 300 days in the year; the fifty-watt incandescent lamp operating one hour per day, 300 days; the 500-watt flatiron 156 hours per year.

As an indication of the upward trend of this business, one central station in New England informs me that last year it executed over six thousand orders covering the charging and sale of batteries for propulsion and ignition purposes.

There are about one hundred central stations in New England where batteries for all purposes can be charged. There are a total of about two hundred battery-charging stations in New England. It is interesting to note that the central stations in some of the larger cities are publishing maps and lists of charging stations, the benefit to be derived from which is obvious.

The electric-vehicle installations of today are well looked after by the inspector. One prominent battery company keeps a large staff of battery inspectors actively engaged all over the country. The electric vehicle needs but a reasonable amount of intelligent attention to make it a success wherever it is put into operation if properly designed for the work to which it is applied.

The position of the electric vehicle for city work is strengthened very greatly by the position taken by the transportation companies, who refuse to admit to their warehouses anything excepting the horse-drawn and the electric vehicle on account of the fire risk. I know of several concerns who are by degrees replacing their horses with elcetrics. What is the stable's loss in tenants is the garage's gain. The public is very gradually but surely adjusting its mind to the new order of things in the matter of transportation. In

proportion, the ox is to the horse what the horse is to the electric, and the unendurable comparison will gradually develop and we will later on marvel at the waste of time, money and energy that has been permitted.

Every business man with an eye to economy is free to admit that the horse is bound eventually to give way to the machine, and health and humanity will eventually demand it.

I have taken particular pains to investigate the experience of the electric in the two recent severe blizzards, and the results would satisfy anyone that the electric is not merely a fair-weather machine.

It has demonstrated its ability to stand up under the severest conditions, and I am pleased to submit herewith one of many replies to my inquiries of electric vehicle users:

THE EDISON ELECTRIC ILLUMINATING CO.
of Boston
General Offices, 39 Boylston Street
Boston, January 29, 1910.

Mr. Frank J. Stone, President,
Elec. Vehicle & Central Station Assn.,
60 State Street, Boston, Mass.

Dear Sir:—

In reply to your favor of January 20th, we are pleased to inform you that we experienced no serious difficulties with our electric vehicles during any of the recent severe storms.

The heavy snowstorm on December 26th, was perhaps the worst of all and put the vehicles to the hardest kind of a test in contending with it.

Our electric vehicles have not lost a day on account of any of these storms, but have run through the deep snow and mud regularly and have performed their work with remarkably good results.

Yours very truly,
(Signed) W. H. FRANCIS,
Purchasing Agent.

The central stations can generate dollars while you sleep without additional investment in machinery, as the heaviest demand comes on off-peak periods. They have been successful in building up the day motor load; there is an equal, if not better, proposition knocking at their door.

Central Stations and the Electric Vehicle.

Under the above caption a number of letters from prominent central stations were printed in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of February 12 last, to show the experiences of the latter in the matter of electric vehicles. The following interesting letter was received too late for insertion in that issue:

"The Edison Electric Illuminating Company, of Brooklyn, is at present taking great interest in the electric vehicle. This apparent sudden interest which the company is taking to promote the use of the electric vehicle is not due to a sudden realization of the current consuming qualities of the electric vehicle, but is due principally to the fact that the company, after watching the operation of the electric vehicle for a period of several years, has decided that the electric vehicle possesses sufficient merit as a mechanical vehicle to warrant commending it to its customers.

"The current-consuming qualities of the electric vehicle are very attractive to the central-station manager,—the average pleasure vehicle consuming from 250 to 300 kilowatt-hours per month, with a demand of only three kilowatts; the commercial type consuming from 350 to 600 kilowatt-hours per month with about the same demand.

"To rejuvenate the interest in the electric vehicle in Brooklyn has been rather an uphill task, owing to the following reasons: (1) Before the electric vehicle was developed as it is today, Brooklynites foresaw the advantages that Brooklyn offered to the electric vehicle. Consequently, there are at present over 200 old-type machines, the operation of which has been anything but satisfactory. (2) During the past two years Brooklyn streets have been in a dilapidated condition, owing to the construction of new subways, which circumstance has made particularly difficult the operation of mechanical vehicles. (3) Brooklyn, up to the present time, has had very poor facilities for caring for the electric vehicle, and those doing work were interested only in the immediate returns from repairs, and in some instances executed the work in a very shabby and unsatisfactory manner and for which very exorbitant charges were exacted. All these circumstances tended to cause the owner of the electric vehicle to lose faith in it.

"In order to develop this class of business, this company has employed a storage-battery and electric-vehicle expert, whose duty is to keep in close touch with all owners of electric vehicles, advise them of the care and attention necessary to insure successful and economical operation, keep them posted as to time and necessity of cleaning their batteries, and see that such work is properly done.

"This company has devoted its energies principally to boosting the commercial vehicle, having paid but little attention, up to the present, to the pleasure type of vehicle. However, it hopes, in the near future, to be able to accomplish some good results with the pleasure vehicle.

"Brooklyn has 350 electric vehicles. During the past six months the company's expert has succeeded in restoring to service ten abandoned machines, which are now operating satisfactorily. During the past six months, fifty new vehicles have been purchased by the company's customers, two of whom have lately placed orders for ten additional machines each.

"The company's electric-vehicle customers at present obtain current for charging batteries on the same basis as the power user, the customer with one vehicle being given a rate of eight cents per kilowatt-hour, while a customer with ten vehicles would earn a rate of five and one-half cents per kilowatt-hour. In view of the increase of this class of business, the company is considering the possibility of allowing an extra discount."

Central-Station Sales Possibilities for Electric Automobiles.

In a newspaper interview at the time of the recent automobile show at Chicago, O. B. Henderson, sales manager of the Baker Motor Vehicle Company, was quoted as follows:

"One of the greatest factors in popularizing and increasing the sale of electric motor cars is the greatly improved charging facilities and enthusiastic co-operation given by central charging stations. In cities where heretofore but little attention has been given to electric motor cars special equipment and facilities for charging them have been installed.

"Central stations are beginning to realize the advantages of supplying current for electrics, and in many instances have equipped establishments, with expert attendants, for charging and caring for their patrons' cars.

"I fully believe that the coming year will show a remarkable increase in sales of electrics, and a large part of this increased demand will unquestionably be due to the enthusiastic co-operation of central stations, the reasonable rates they are making for electric current and their careful attention to the requirement of electric cars."

ELECTRIC LIGHTING and ILLUMINATING ENGINEERING

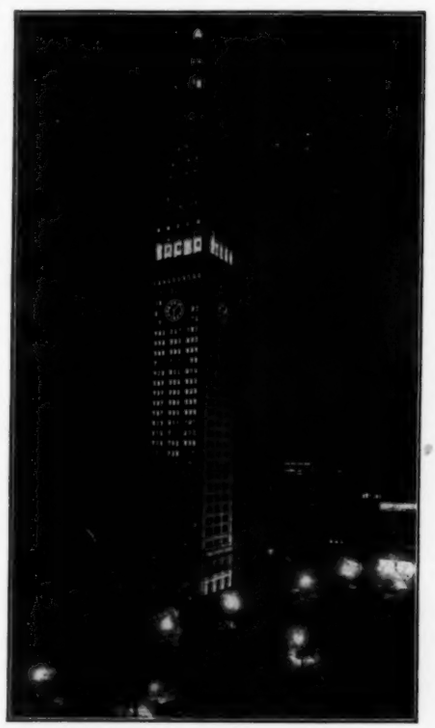
THE METROPOLITAN TOWER CLOCK IN NEW YORK CITY.

BY JOSEPH B. BAKER.

The illumination and chimes of the clock in the tower of the Metropolitan Life Building, in New York city, are of great spectacular interest to visitors to the metropolis. The New Yorker desiring to impress friends from out of town conducts them to Madison Square at about nightfall, and stations them say at the corner of Twenty-third Street and Fifth Avenue, where a good view may be obtained of the tall white tower looming up in the evening air. At 4:50 o'clock on a midwinter afternoon the dials, at the twenty-sixth floor (nearly 350 feet above the sidewalk), are suddenly outlined in fire,—hands, dial numerals and minute marks gleaming like burnished gold in the gathering darkness. Ten minutes later the ear, too, is gratified; for the chimes—the four beautiful measures of the old English air known as the "Cambridge quarters"—sound from their belfry some 270 feet higher up on the tower, followed by the solemn tones of the deepest of the four bells striking the hour. To cap the climax (literally as well as figuratively), the audible chimes which announce the time to the ears of all people nearby are accompanied by "visual chimes," making the same announcement to all eyes within a radius of some fifteen miles by flashes of white and red light from the lantern at the tip-top of the tower, 700 feet above the street.

The whole grand and inspiring effect is made possible by electricity. Beginning with the "master clock," the soul and center of all this system, installed in the Directors' Room of the Metropolitan Life Insurance Company on the second floor of the building, and clear through every horological detail to the topmost lamp at the apex of the tower, the entire clock system is an electric lighting and power proposition. The illumination of the clock faces and flashlight lantern is accomplished by novel and striking means, especially worked out for this installation. The successful result is an effect hitherto unprecedented, not only in magnitude but in pleasing excellence.

In the clock-face illumination, the problem was to make the great dials actually as readable at night as by day. To accomplish this required the working out of a unique illuminating idea,



NIGHT VIEW OF METROPOLITAN TOWER.

adapted to the special conditions of four dials twenty-six feet in diameter at their immense height on the tower.

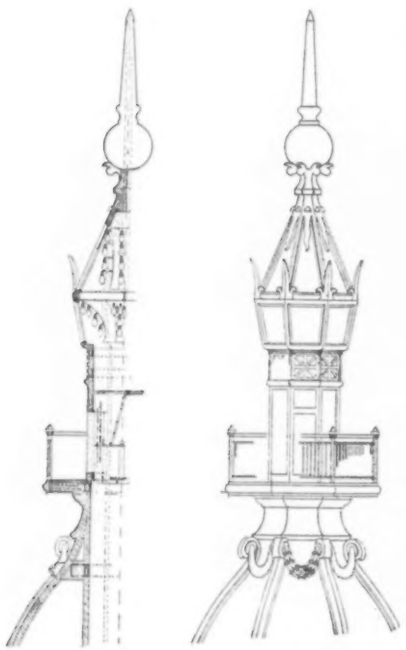
In most illuminated tower clocks the dial is less distinct at night than by day, not only on account of deficient or imperfectly distributed lighting, but also because of a blurring effect. If the dial is opaque, and lighted up from the outside, a weak or irregular illumination is obviously unsatisfactory, and a strong illumination kills the necessary contrast of the dial numerals against their background. A translucent dial illuminated from behind is generally an improvement, but the effect is still disappointing, on account of irradiation, causing fringes of light or "poor definition" at the edges of the numerals and hands. Attempts to increase the contrast by outlining the numerals and hands in incandescent lamps would simply exaggerate the blurring, making the clock still more difficult to read from any considerable distance.

In the Metropolitan clock-face these defects are scientifically overcome by employing an opaque dial of dead-white surface on which the numerals and minute-marks are inscribed by cutting them entirely through the surface forming the front wall of a sort of box, or dial casing, projecting out thirty inches from the wall of the tower. Thus by day the numerals and minute-marks, with the unlighted cavity behind them, show a good contrast with the daylight-illuminated front surface of the dial—like the figures cut in a stencil. The hands are of steel frame construction, sheathed with copper, and the hands, numerals and minute-marks are faced with polished plate wire-glass. The numerals are four feet high and the minute-marks ten and one-half inches in diameter. The whole makes a clock-face which is so sharp and distinct that it may be read as far as it can be seen at all.

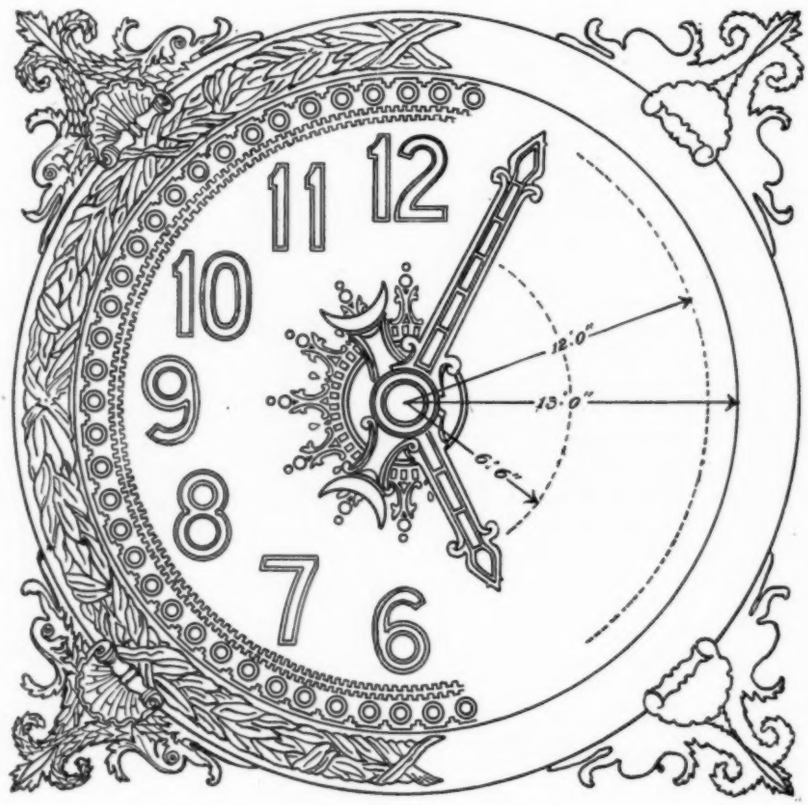
The special illumination makes this statement equally true of the dials as they appear at night. The entire interior of the dial casing is painted a permanent dead-white, having a high efficiency for diffused reflection of light, and is lighted up at night by two concentric circular rows, thirteen feet and twenty-four feet in diameter, of twenty-candlepower General Electric tungsten lamps, 200 in each dial, mounted with individual Frink reflectors of corrugated, silvered glass which throw all of the direct rays against the rear wall of the casing. The effect is to illuminate the glass fronts of the

numerals and minute-marks powerfully and evenly from behind (the dial face being wholly unilluminated). The glass fronts of the hands are similarly lit up, from within their bodies. The whole clock-face therefore shows with ideal brilliancy and distinctness in the dark night sky.

One of the most interesting engineering features of the clock-face illumination is the means provided for renewing the lamps. The lamps in the dial casing, which are screwed into ordinary receptacles, are readily accessible by steel ladders and platforms leading out from the clock-room back of each dial. The lamps in the hands are of two kinds: ordinary shaped bulbs for a center cluster defining the boss of the minute-hand, and "Linolite" lamps for the pointer sections of the hands, all being accessible from the clock-room through shuttered windows at the center of the dial. The eight lamps forming the center cluster are held by receptacles mounted in two groups of four lamps each on sectors of scrap iron. A cast brass lug with thumb-nut serves to hold the sector in place. In wiring the cluster, plenty of slack wire is left between the sectors, and by opening a slide in the copper casing at the back of the minute hand and reaching into the casing the thumb-nuts may be loosened, allowing either sector to be withdrawn for the purpose of renewing its lamps. The Linolite lamps, mounted in sections 13.75 inches long, lengthwise with the hands, give a nearly continuous double line of light which defines the hands at night better than a row of ordinary shaped bulbs. The lamps are arranged on a hinged, folding frame—two lamps side by side in each leaf of the frame, with slack in the wiring between adjacent leaves—whereby the entire seat can be withdrawn through a sheet-copper slide in the hand near its point of attachment to its arbor. The inside surfaces of the hands, back of the center cluster and rows of Linolite lamps, are painted dead-white to give good diffused reflection.



THE METROPOLITAN TOWER LANTERN.



DIAL OF METROPOLITAN TOWER CLOCK.

The hands of each of the four dials are driven by duplicate electric motors through a worm shaft. Both motors start up and run for fifty seconds out of each minute, under control of the distant master clock. As a precaution against breakdown, either motor will carry the load alone, and special arrangements are provided for announcing in the electrician's office any trouble that may occur on either.

The chimes consist of a massive "announcing bell," weighing 7,000 pounds and giving the note B-flat, and three other bells, weighing 3,000, 2,000 and 1,500 pounds respectively and giving the notes E-flat, F and G. These bells are hung one on each of the four sides of the tower, and are electrically struck by quick-acting solenoid-operated hammers, the mechanisms of which are protected from the weather by copper casings. For striking the hours, on the heaviest and deepest-toned bell, an extra heavy hammer (150 pounds) is employed, giving the hour-strike with an entirely different effect from the note obtained from the same bell in chiming the quarters. The energy consumption at the instant of striking is six electrical horsepower.

The flashing lantern at the top of the tower consists of a strong plate-glass casing, inside which are mounted a group of eighty-eight G. E. plain tungsten incandescent lamps and a group of fifty-six similar red lamps, of 100 and 250 watts rating respectively and an aggregate candlepower of over 18,000. These lamps are held in receptacles mounted on reflecting surfaces, and are intermingled, red and white lamps together over a large area, yet so arranged that when the white lamps are burning the light from them streams out from the lantern without passing

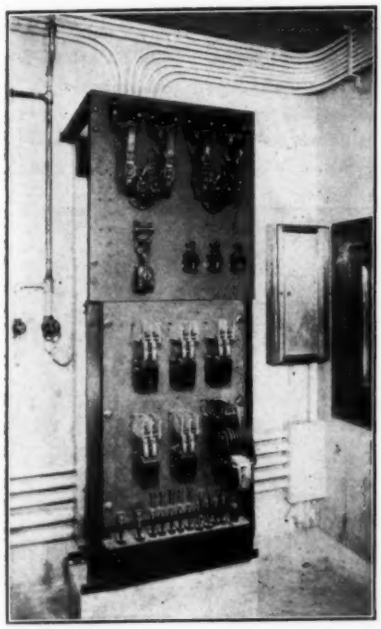
through the globes of the red lamps, thus maintaining the purity of the white-light flashing. In operation, the white light burns through all the night, except just before the time to announce each quarter hour, at which time it is extinguished preparatory to the flashing. The hour of five o'clock, for example, is announced by four red flashes for the four quarters, followed by five flashes of the white light for the hour.

All of this equipment—tower clock movement, chimes, and flashing arrangement—is electrically operated, and electrically controlled from the master clock, which is itself electrically driven, it being of the "Self-Winding" type. This timepiece was installed under a guarantee to run within five seconds a month of true time, and has in fact not exceeded three seconds' deviation a month. It has a mercury-compensated pendulum, and is contained in a magnificently carved mahogany case, matching and harmonizing with the furnishings of the Directors' Room in which it stands. Enclosed in the lower part of the case, behind a plate-glass door, is the auxiliary controlling apparatus, consisting of a main transmitter, a chimes transmitter, an hour-strike transmitter, seven pilot clocks included in independent secondary clock circuits installed throughout the building, single-pole switches in these clock circuits and press-buttons for setting the clocks independently of the controlling movement, and ballast adjustable resistances to compensate for a greater or less number of clocks in given circuits. The master clock and all of the transmitters are independently self-wound by electric motor winders operated from special batteries.

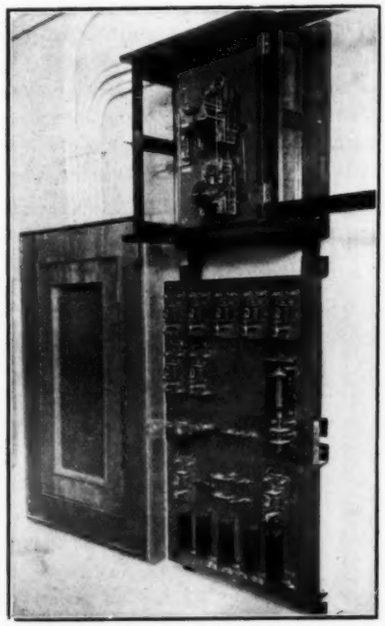
The master-clock contacts, by closing and opening circuits supplied by a low-voltage battery, actuate special relays in the west tower-clock room on the twenty-sixth floor. These relays actuate the heavy remote-control switches, installed in the same room, for closing the lighting feeder circuits for the dials and hands, the cables leading to the chimes and hour-strikers, and the feeders supplying the lantern. Thus comparatively feeble currents, controlled at the master-clock, in turn control the considerable distribution of direct-current electrical energy consumed in the clock and lantern illumination and the operation of the chimes, all of which is supplied by the building service mains. The generating plant in the building was described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of November 6, 1909.

The Metropolitan Building clock schedule provides for the operation of the chimes from 8 a. m. to 6 p. m., and for the flashing of the hours and quarters from the lantern from twenty minutes after sunset to twenty minutes before sunrise. In order to cut the chimes in and out at the hours stated, and the flashing equipment in and out at progressively different times of the day with advance of the season, an automatic contact device, operated by the mechanism of one of the tower dials, is employed.

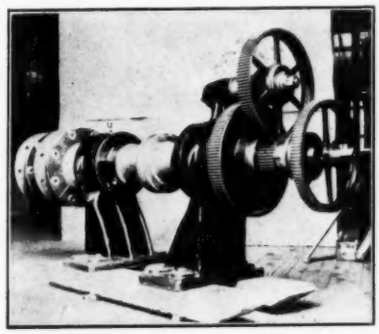
The magnitude of this horological marvel is strikingly shown in the illustration of the "dial works" for one of the tower clock faces—the minute-hand and four-hand arbors and their gearing. The gear at the right is keyed on the minute-hand arbor, running through to the pair of flanges at the left, which carry the hand. This hand is seventeen feet long and weighs 1,000 pounds. The gear at the left is fast on the hour-hand sleeve, which extends through to the other pair of flanges for carrying the hand. The hour hand is thirteen feet long and weighs 700 pounds. This view also shows the collector rings for supplying current for the hour-hand lamps. The motors for driving this mechanism are not shown in the illustration.



SWITCHES FOR LIGHTING CLOCK AND LANTERN, AND STRIKING CHIMES.



RELAYS FOR GOVERNING LIGHTING AND CHIMES OF CLOCK.

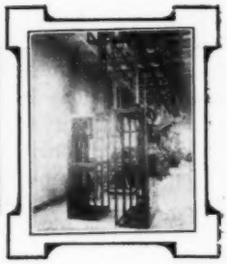


DIAL WORKS TO WHICH THE HANDS ARE ATTACHED.

Studies Electrolysis with the Ultramicroscope.

Dr. J. J. Kossonogow, in an article which appeared in a recent issue of the *Physikalische Zeitschrift*, describes some researches with the ultramicroscope. In examining an electrolyte under the ultramicroscope, he observed, at the moment when the current is switched on, a number of bright points of light which travel toward the electrodes at velocities comparable with those of ions. The paths may be deflected by magnetic influence. Each of the light points assumes a crystalline form when it reaches an electrode and attaches itself thereto. The author concludes that he has opened up a new field for the investigation of the motion of ions in electrolysis.

Industrial Power



ELECTRICALLY DRIVEN PUMPS.—VII.

THE HIGH-PRESSURE FIRE-SERVICE PUMPS OF MANHATTAN BOROUGH, CITY OF NEW YORK—PART II.

The motors and pumps, with suction and delivery branches, are located on the main floor of the pump room. The switchboard and switchboard apparatus are placed in an inclosed two-story and basement galley.

The four high-tension feeders and all other wires entering the building are brought in through the gallery basement. All terminal work on the entering wires is located in the basement. On the first floor of the gallery, which is approximately on the same level as the pump-room floor, are placed the oil switches, with their controlling and protective devices, fireproof cells and compartments.

The operating switchboard is conveniently located in the inclosing wall of the gallery, and is so placed as to allow a man standing on the pump-room floor to perform all of the operations necessary for controlling the apparatus in the station. The busbars, with their fireproof compartments, are placed on the second floor of the gallery.

Each pump is direct-connected to its motor by a flexible coupling which takes care of any variation from alinement. The motors are of the constant-speed reduction type, three-phase, twenty-five-cycle, 6,300-volt to 6,600-volt, designed to operate at about 740 revolutions per minute. The motors are of the wound-rotor type, and, in starting, an iron grid resistance is connected in the secondary circuit and gradually cut out by means of a handwheel on the motor switchboard panel. When the resistance is all cut out the rotor is automatically short-circuited and operated by specially constructed solenoids which are operated by a small

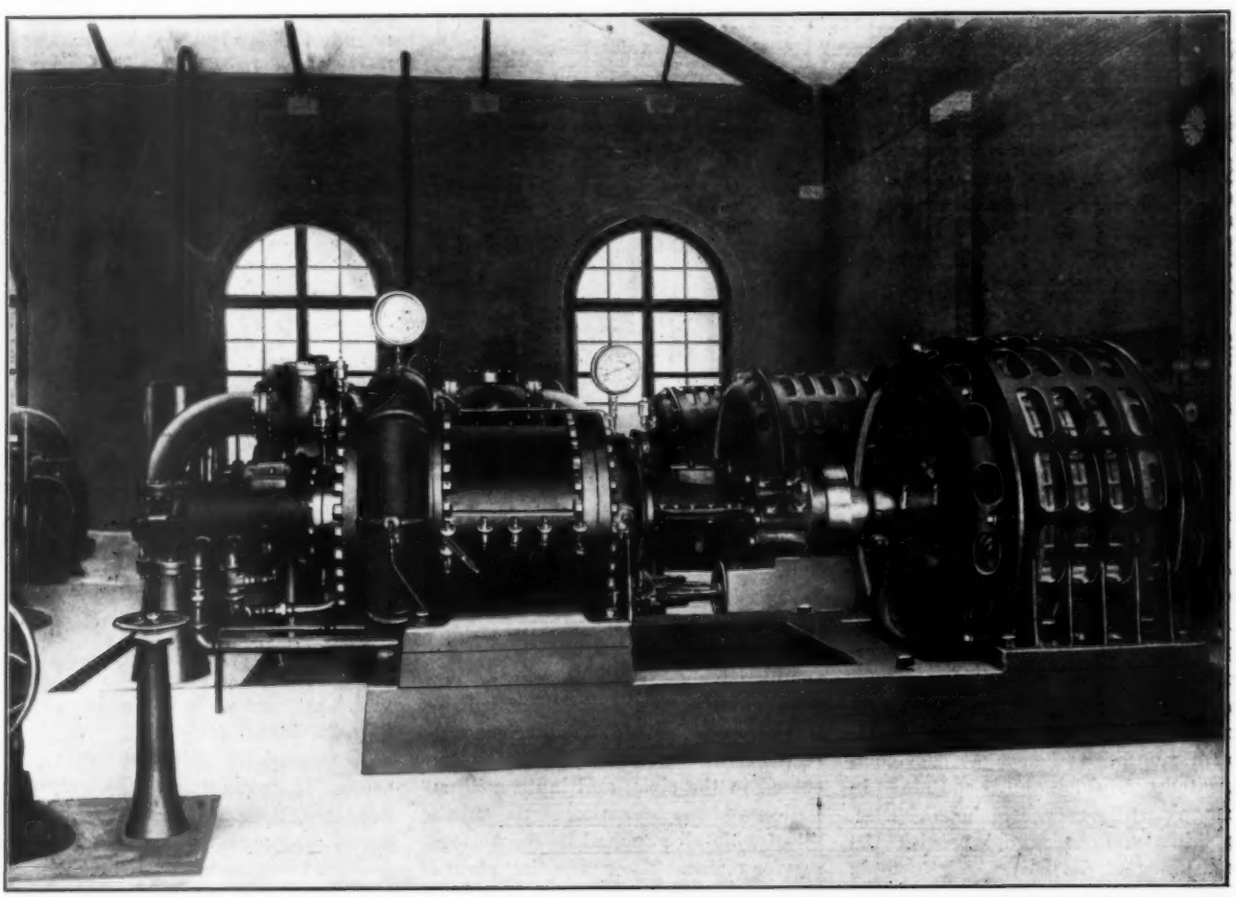


FIG. 3.—INTERIOR VIEW OF PUMPING STATION SHOWING MOTOR-DRIVEN CENTRIFUGAL PUMPS INSTALLED FOR THE MANHATTAN HIGH-PRESSURE FIRE SERVICE, NEW YORK CITY.

switch mounted directly on the shaft of the handwheel referred to above. An interlocking arrangement prevents the operator from closing the switch connecting the motor to the line while the motor is short-circuited.

The specifications required the motors to have sufficient starting torque to attain full speed between thirty seconds and forty-five seconds after starting, with a current not exceeding 150 per cent of that used when the motor is working under full speed. Each motor was required to develop not less than 800 brake horsepower when using current of 6,300 volts, twenty-five cycles, and under these conditions to have an efficiency not less than ninety-two per cent, a power factor not less than ninety-three per cent, and a motor slip not in excess of two per cent. At three-quarters load the efficiency was not be less than ninety-two per cent. and the slip not to exceed 1.5 per cent. It was specified that the temperature of the motors should not rise more than forty per cent on a twenty-four-hour test at full load when measured by a thermometer, the air in the room being twenty-five degrees centigrade.

Prof. Geo. F. Sever of Columbia University tested two of the motors in the shops of the contractor and found them to meet the specifications and to have a full-load efficiency of 93.2 per cent. The other motors were inspectd and found to be alike and were assumed to have the same efficiency. The motors were also tested for temperature rise at the time of the official test to be described later.

Direct-current motors of 240 volts are provided to operate the various gate valves in the station and the piston pumps employed for maintaining a vacuum on the salt-water suction lines.

As previously stated, the pumps were finally constructed with five stages, each to give a pressure of somewhat over sixty pounds per square inch, making the combined pressure of the five stages about 300 pounds per square inch above the intake pressure, which is the maximum working pressure of the stations at normal speed of 740 revolutions per minute. This type of pump is the simplest now on the market for pumping water either against a high head or low head, and this simplicity was the deciding factor which led to the selection of this style of machinery.

The pumps are water-balanced by a piston connected to the last impeller and upon which the water pressure acts, but should any additional end-thrust occur, it would be taken up by the ball bearing provided in the outboard bearing. This ball bearing consists of two rings of one and one-half inch diameter steel balls and is water-cooled. The balancing piston is fitted very loosely in order to keep the friction losses small, and as a result a considerable amount of water leaks past it into a chamber at the end of the pump, which is provided with a discharge pipe and valve leading into the suction. By adjusting the valve in this pipe the difference of pressures on the piston can be regulated as desired. The bearings are of the ring-oiled type and are separated from the pump casing by packing glands which prevent foreign matter from entering the bearings. The impellers are of bronze and the shaft of forged steel. All parts of the runners and diffusion vanes are thoroughly lubricated by oil cups on the base of the pumps. A feature is the wide base which allows the pump barrel to set low, giving stability.

Each combined unit is equipped with automatic and hand control. The pumps are kept primed for instant service and the simple operation of a switch on the main switchboard starts the machine and gives full pressure in about thirty seconds.

A combined regulating and relief valve is interposed between the discharge pipe and the suction pipe of each pump, and set to regulate the discharge of each pump to any predetermined pressure. When the volume of the water discharged by the pump is in excess of that forced into the system, the valve acts as a relief valve and by-passes this excess into the suction of the pump, the pressure on the main distribution system remaining at the predetermined point. When no water is forced into the distribution system all of the water discharged from the pump is then by-passed into the suction.

The priming apparatus in each station consists of three motor-driven vacuum pumps, each arranged to maintain automatically a vacuum of twenty-six inches in the suction lines. These pumps are of the piston single-action type, one having a displacement capacity of 300 cubic feet per minute for a piston speed of 200 feet per minute and each of the others a displacement capacity of fifty cubic feet with a piston speed of 160 feet per minute.

An air-collecting chamber is connected to each of the salt-water suction lines and equipped with water-gauge glass and vacuum gauge. The air-suction piping between the air chambers and the air pumps is provided with a vertical loop sufficiently high to prevent water being carried over to the pumps. The air pumps are interconnected to each air chamber.

Venturi meters for measuring the discharge of water from the station and from one main to the other were set by the contractor on each discharge main and on the cross-connecting main. The meters of the discharge main are twenty-four inches in diameter and on the cross-over main twelve inches in diameter. These meters were standardized under the direction of F. N. Connet, chief engineer of the Builders' Iron Foundry, Providence, R. I., and were provided with dial-indicating gauges and also chart-recorders graduated to indicate the flow in gallons per minute; and in addition with an integrating meter which registers the total flow in gallons.

The readings during the test were taken by a mercury manometer, graduated to show the capacity in thousands of gallons per minute. For this purpose a Venturi manometer was attached with a temporary connection to each of the twenty-four-inch Venturi tubes. The manometer gave essentially the same reading as the indicating dial on the main register.

The Venturi manometer is practically a tube partly filled with mercury, one side of which communicates with the upstream pressure chamber of the meter tube, while the other communicates with the throat-pressure chamber.

The specifications for the pumping system provided for an endurance test of each motor and pump lasting twenty-four hours without stop, during which time the capacity and efficiency of the pumps and motors was to be determined. The tests were to be in charge of an expert appointed by the commission.

The specifications provided for making the test with sea water, but this was later changed to a test with Croton water under the conditions of actual use. In view of this change the contractor increased the efficiency guarantee from seventy to seventy-one per cent.

The original specifications called for a capacity of 3,000 gallons of sea water per minute against a discharge pressure of 300 pounds per square inch and a suction lift not exceeding twenty feet. The total increment of pressure is equivalent to 308.66 pounds from the intake to the delivery side. The Croton pressure varies at the stations in different parts of the day from about forty pounds to thirteen pounds per square inch and is affected by the amount of water being drawn from the mains. Consequently, to meet the requirements, the delivery pressure would need to be 308.66 pounds in excess of the intake pressure. There is also a further correction from the fact that sea water is heavier than fresh water and this correction under maximum conditions might amount to 2.5 per cent.

The specifications further provided that the brake horsepower developed by the motors under test should be computed from the electrical energy supplied to them, corrected for the efficiency of the motors as determined by the test. They further provided that if the aggregate of all stops exceeded one hour for any motor the test for capacity for such motor was to be run over again for a period of twenty-four hours.

The specifications also provided that the pumping capacity of the apparatus and the efficiency of the pumps should be based on the minimum rate of pumping during any eight consecutive hours of the endurance test, during which none of the motors were stopped.

The discharge of the pumps was determined by the reading of the Venturi meters, one of which was located in each discharge line. These readings were under the direction of F. N. Connett, and were checked by observers representing the contractors and also the city.

The modified specifications also required that the efficiency of each pump should be not less than seventy per cent and its capacity not less than 3,000 gallons of sea water when lifted to a pressure equivalent to 308.66 pounds. To determine whether the requirement was met, a separate test of each pump was required.

The test of the South Street station was begun at 12:30 p. m. on September 2, 1908, after about two hours of preliminary running for the purpose of adjusting the delivery pressure; it was continued without interruption for twenty-four hours. With the exception of a short stop of motor No. 2, which was shut down from 2:11 to 2:41 a. m., September 3, to remedy a slight defect in the insulation of the field coils, no pump was stopped. During the time No. 2 was stopped the pressure on the delivery mains fell to about 300 pounds; during the remainder of the test the pressure was maintained at or above the contract requirement.

The average results for each hour for the twenty-four-hour test of all four motors showed that the delivery every hour was largely in excess of the contract requirement of 15,000 gallons. The smallest delivery for eight consecutive hours occurred at the last part of the test, when the average capacity, as shown by the readings, was 18,447 gallons per minute, and the average efficiency was 72.2 per cent. During this time the average pressure pumped against was 314.5 pounds, or an excess of about six pounds over contract requirement.

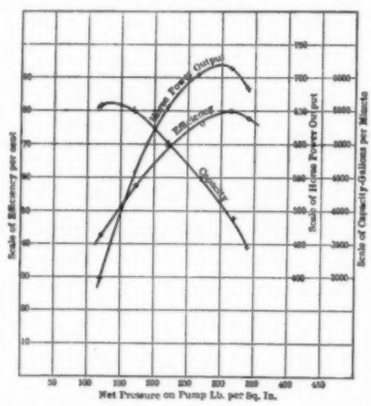

Brake Horse Power Output
Efficiency
Capacity
Scale of Efficiency per cent
Scale of Brake Power Output
Scale of Capacity-Gallons per Minute
Net Pressure on Pump Lb. per Sq. In.

FIG. 4.—CHARACTERISTIC CURVES OF THE PUMP SHOWING VARYING DISCHARGE-PRESSURES.

During the test of the South Street station all the bearings ran cool with the exception of those on No. 6 pump, which heated up during the third and fourth hours, but were brought to a normal condition without stopping the pump or reducing its load by the application of lubricants and cooling water.

The average results of the twenty-four-hour test of the South Street station exceeded the contract requirements in capacity, pressure head and efficiency.

The horsepower delivered by the motors during the test averaged, for the twenty-four hours, about 920, or about fifteen per cent above rating, without excessive heating.

Immediately after the close of the endurance test of twenty-four hours, a short test was run on each motor separately, which was continued long enough after uniform results were shown to obtain twelve to fifteen readings. This test was run for the purpose of ascertaining whether there were deficiencies in any of the individual motors, and to meet the requirements specified in the printed specification for the work, viz.; that each pump should be free from defects, should have a capacity of 3,000 gallons per minute and an efficiency not less than seventy per cent. The results of this test showed that the individual pumps operated singly had an efficiency from four per cent to six per cent in excess of the average when operated together, and that the capacity for the specified discharge pressure was considerably in excess of the requirement of the specification. It is generally the case that individual centrifugal pumps delivering water into a main singly show a greater efficiency by from four per cent to six per cent than the same pumps delivering together into a single main, due probably to less loss in eddy currents and friction head, etc.

The endurance test of the Gansevoort station with all the pumps in operation was begun at 9:45 a. m., September 5, after the pumps had been operated for about twenty minutes giving uniform results. The test was continued for twenty-four hours. The method of testing and the various observers were the the same as described in reference to the South Street station.

For the Gansevoort station the efficiency average for 24 hours was 72.9 per cent, with a variation (excepting the first hour) of less than one-half of one per cent. It fell below seventy per cent during the first hour, which was due to the opening of an automatic relief valve on pump No. 2, which discharged some of the water into the suction before it had been metered. For that reason the efficiency during the first hour has not been considered in determining the performance of the pumps.

The least capacity during the eight consecutive hours when all the water pumped passed through the meters occurs from 10:45 a. m. to 6:45 p. m. The average capacity during this time is 17,419 gallons, or about 16.5 per cent above that guaranteed. The average net pressure in pounds is 324.3, which

is nearly sixteen pounds in excess of the contract requirements. The average efficiency for the period above is 72.90 per cent, which is nearly two per cent in excess of the efficiency guaranteed.

The average capacity for the entire test is 17,867 gallons, which was obtained with an average speed of 753.6 revolutions per minute.

Immediately after the completion of the endurance test of twenty-four hours' duration, each pump was tested when operating alone for a period sufficiently long to obtain twelve to fifteen readings after they had become practically uniform. These tests gave in every case an efficiency several per cent greater than that obtained when the pumps were all discharging into the same main.

It appears from the endurance test in each station that the capacity, efficiency and pressure exceeded the contract requirements by a large margin, and that during the endurance test no mechanical or electrical defects were observed. During the test of the South Street station one of the pumps was stopped for half an hour to repair the motor insulation, while during the test of the Gansevoort station no stop of any kind was made. The bearings in both stations were in perfect condition at the end of the test and the temperature of the motors not sufficiently high to interfere with the continuous operation for a longer period. Apparently the endurance test could have been continued indefinitely without injuriously overworking or overloading the pumps and motors.

The specifications call for pumping sea water, which most authorities consider to be approximately 2.5 per cent heavier than fresh water. The effect of substituting sea water for fresh water would, for the same horsepower delivered by the motor, have been to reduce the capacity of the pump by about two and one-half per cent without sensibly affecting the efficiency. Because of the large capacity over contract requirements shown by each pump, this amount does not materially affect the results.

The high-pressure fire system in New York, which was put officially into service on July 6, 1908, has been successfully operated at many fires, but it had a crucial test on January 7, 8 and 9, 1909, when it was brought into service for five simultaneous fires, three of them of more than the usual extent and activity, and one particularly so. Information upon the results attained with the system and the amount of water consumed was given by Chief Engineer I. M. de Varona and published in *Engineering News* of February 11, 1909.

The fires occurred at Hudson and Franklin Streets, Hester Street and the Bowery, Houston Street and Broadway, Sixth Avenue and Seventeenth Street, and Houston Street and the Bowery.

As the violence of the fires increased, additional pumps were brought into service, so that at one time four pumps and motors were in commission at the South Street station and three pumps at the Gansevoort Street station, delivering 35,500 gallons per minute against an average pressure of 225 pounds at the pumps and 205 pounds at the hydrants. During the operation of the pumps 14,095,000 gallons were pumped as recorded by the meters, and the current used was 81,450 kilowatt-hours, the cost of which was $1,222.

The high-pressure system was designed by I. M. deVarona, Chief Engineer of the Department of Water Supply, Gas and Electricity of New York. It was also constructed under his supervision. The construction of the electrical machinery was supervised by Prof. Geo. F. Sever as Consulting Engineer. The details of construction were in charge of Thomas J. Bannon, John P. Reynolds and Henry B. Machon, assistant engineers of the department. The machinery of each station was designed and erected by the Allis-Chalmers Company, of West Allis, near Milwaukee, Wis.

(To be continued.)

Electrical Generators for the Rjukanfos Waterpower Development.

There have been recently ordered for the great hydroelectric development at the Rjukanfos Falls, in Norway, five alternating-current generators of extremely large size, and which possess many special features of interest. The accompanying diagram shows various views of one of these machines.

Each generator is capable of generating 17,000 kilowatt-amperes, at a pressure of 10,000 to 11,000 volts, a frequency of fifty cycles per second, and a power factor of 0.6,—this at a speed of 250 revolutions per minute, with each machine consuming about 14,450 horsepower. The machines are direct-connected to 130-kilowatt, 220-volt exciters.

All five machines will be directly driven by water turbines, and will be used to operate the electrochemical factory of the Rjukanfos Company for the manufacture of air nitrates. Thus they will be exposed to great variations of pressure and to violent short-circuiting. Four of these generators will be constructed as double generators, with only one shaft for each of them and with but two buses. Between the two stators a fireproof partition will be built to prevent the leaping of fire that may originate in the armature of one generator, into that of the other.

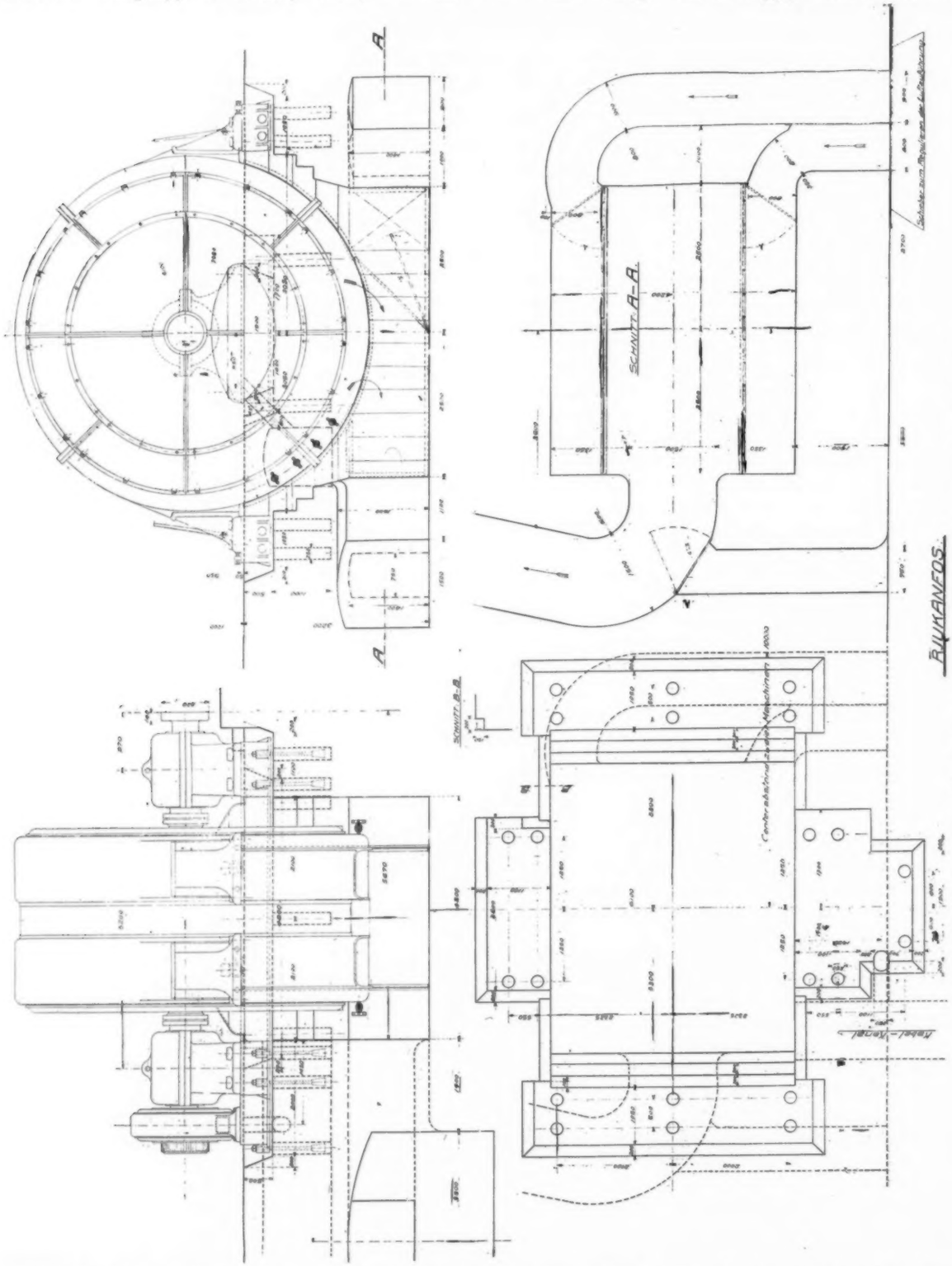
The guaranteed full-load efficiency, all losses by ventilation and friction considered, will amount to 94.8 per cent for the double generators, and to 95.3 per cent for the single generator. The tension changes in consequence of sudden variations of pressure, from zero to full load and vice versa, will amount to 3,800 volts in the one case and to 2,400 volts in the other. The total weight of each of these generators amounts to 205,000 kilogrammes, of which weight 92,000 kilogrammes are represented by the rotating field (with shaft), and about 90,000 kilogrammes by the stator proper.

The stator consists of a strong cast-iron casing in which the active iron is fastened by means of swallowtail-shaped springs, and held together by strong press-plates reaching to the cogs—an arrangement from which secure and noiseless operation may safely be expected. The stators are arranged movably in the direction of the axles so that future repairs can easily be effected. The exterior diameter of the stators measures about six metres, the interior 4.4 metres, and the height of the iron core 215 millimetres. The machines will be of the closed-draft type, and will be provided with openings permitting the use of part of the hot air for heating the machine-room.

The arms system and the hub of the rotating field consist of cast-steel, while the wheel tire is composed of single wrought rings. The cast-steel poles have laminated pole shoes; they are let into the tire by means of swallowtails, and are secured by a proper arrangement of spikes. The pole armature consists of high-edged copper wire. All pole windings are switched in row and keep the excited current over the steel brush rings, on which press the carbon

brushes. Each rotor will be tested in the works of the manufacturers (the Brown-Boveri Company, of Baden, Switzerland) for half an hour under 1.8 times the normal number of revolutions, that is, at 450 revolutions per minute, so that they probably will stand even the greatest mechanical pressure that may be exercised on them, as in case of a turbine racing.

The measurements for the bearings are liberally large. Forced oil lubrication is provided for the bearings, but, for safety they will also be provided with lubricating rings and with a water-cooling arrangement, so that in case the oil supply should cease from any cause, the operation may be continued with ring-lubrication and the cooling be effected by means of the water-jackets.



ELECTRICAL GENERATOR FOR THE RJUKANFOS WATERPOWER DEVELOPMENT.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

ST. LOUIS COUNTY GAS AND KING ELECTRIC.

The St. Louis County Gas Company and the King Electric Company report consolidated earnings for the year ended December 31, 1909, as follows:

Gross revenue	$170,337
Operating expenses, taxes and reserves	128,611
Net revenue	$ 41,726
Interest charges	15,443
Surplus	*$ 26,283

* Equal to earning 8.48 per cent on $310,000 capital stock.

PHILADELPHIA COMPANY.

The Philadelphia Company and affiliated corporations report for the year ended December 31, 1909, which compares with former years as follows:

	1909	1908
Gross	$18,247,516	$16,583,425
Expenses and taxes	10,338,535	9,718,870
Net	$ 7,908,981	$ 6,801,555
Other income	281,272	245,730
Total income	$ 8,190,253	$ 7,047,285
Charges	4,583,453	4,483,079
Balance	$ 3,606,800	$ 2,564,206
Preferred dividends Philadelphia Company	300,000	300,000
Surplus	$ 3,306,800	$ 2,264,200
Due owners and common stock affiliated companies	3,778	3,645
Surplus available Philadelphia Company	$ 3,303,021	$ 2,260,561

Items representing transactions between companies have been eliminated in this report.

UNION ELECTRIC LIGHT AND POWER.

The Union Electric Light and Power Company reports for the year ended December 31, 1909, compared as follows:

	1909.	1908.
Gross revenue	$3,085,614	$3,013,297
Operating expenses, taxes and reserves	1,503,034	1,551,156
Net revenue	$1,582,580	$1,462,141
Interest charges	834,204	804,499
Surplus	*$748,376	$656,643

*Equal to 7.58 per cent on $9,885,000 capital stock outstanding.

NORTHERN OHIO TRACTION AND LIGHT.

The Northern Ohio Traction and Light Company has issued its annual report for the year ended December 31, 1909. The full income account compares as follows:

	1909.	1908.
Gross	$2,177,642	$1,890,473
Expenses and taxes	1,190,057	1,086,423
Net	$987,585	$804,050
Charges	524,066	526,532
Surplus	*$463,519	$277,517
Dividends	157,500	134,151
Surplus	$306,019	$143,366
Previous surplus	782,942	751,582
Total surplus	$1,088,961	$894,948
Depreciation, etc.	141,794	112,007
Power and light surplus	$947,166	$782,941

*Equal to 4.63 per cent on $10,000,000 capital stock, compared to 2.77 per cent earned on same stock last year.

UNITED POWER AND TRANSPORTATION.

The income account of the United Power and Transportation Company, an important subsidiary of the Interstate Railways Company for the year ended December 31, 1909, compares as follows:

	1909	1908
Income from securities owned	$382,289	$688,284
Expenses, taxes, interest, etc.	367,614	362,799
Surplus	$ 14,675	$325,485
Previous surplus	592,770	267,285
Total surplus applied to div'd	$607,445	$592,770
Dividends	.....	.....
Power and light surplus	$607,445	$592,770

AMERICAN DISTRICT TELEGRAPH OF NEW JERSEY.

The annual report of the American District Telegraph Company of New Jersey for the year 1909 is not completed, but a preliminary statement has been issued which shows as follows, with the month of December estimated:

	1909	1908	Increase
Gross earnings	$3,600,000	$3,192,000	$408,000
Expenses	2,700,000	2,407,000	293,000
Net earnings	$900,000	$785,000	$115,000
Dividends	398,496	398,088	408
Surplus	$501,504	$386,912	$114,592

Directors of the company were reelected at the annual meeting; they are: Robert C. Clowry, George H. Fearson, Thomas F. Clark, George W. E. Atkins, Henry A. Bishop, J. C. Barclay, B. Brooks, H. D. Estabrook, L. F. Loree, U. N. Bethell and C. F. Patterson.

Stone and Webster Report Earnings.

The Boston banking house of Stone & Webster has just made public the combined statement of the thirty public service companies under its management. A representative of this firm heads the bondholders' committee in New York city tractions, and under his supervision a complete survey of the New York situation has been made. The extent of the operations of the house and its business in 1909 is shown in the following statement:

COMBINED CAPITALIZATION—THIRTY COMPANIES.

Bonds and coupon notes outstanding	$ 62,997,500
Preferred capital and common stocks outstanding	63,198,120
Total	$126,195,620

TOTAL EARNINGS AND EXPENSES, 1909.

Gross earnings	$ 20,241,974
Operating expenses	11,582,862
Net earnings	$ 8,659,112
Interest charges and taxes	4,496,350
Balance	$ 4,162,762
Dividends paid	1,972,186
Balance	$ 2,190,576
Total disbursements for the year 1909 for interest on bonds and notes and for dividends	5,298,016
Miles of equivalent single track operated	1,005
Passengers carried	274,567,000

Total connected electric lighting load equivalent to 1,778,000 16-candle power lamps.

Total commercial power load approximately 83,638 horsepower.

Total combined power station capacity, approximately, of which 55,868 horsepower is generated by water power, 167,262 horsepower.

Chicago Telephone Company.

Gross earnings of the Chicago Telephone company for the fiscal year ended December 31, 1909, were $9,907,499, an increase of $1,165,932, or 13.3 per cent over the preceding year. The showing, in fact, was the largest in the history of the company. The net earnings were equal to 8.22 per cent on the capital stock of $27,000,000. The company paid in dividends 8 per cent, leaving a surplus of $60,707 for the year. The net earnings, at $2,220,707, were the largest in the company's history. The operating ratio was 77.58 per cent, compared with 76.27 per cent the previous year. The company's total surplus now stands at $745,385.

The revenue and expenditures are as follows:

	Dec. 31, 1909.	Dec. 31, 1908.	Dec. 31, 1907.
Gross earnings	$9,907,449	$8,741,517	$8,718,951
Operat. expenses	4,579,534	4,064,940	6,976,868
Repairs and maintenance	3,107,207	2,603,236	.....
Net earnings	$2,220,707	$2,073,341	$1,742,083
Dividends	2,160,000	2,012,790	1,472,713
Surplus	$ 60,701	$ 60,551	$ 269,370
Per cent expense	77.58	76.27	80.02

The growth of the company's plant and its financial expansion in the past five years is illustrated by this table:

	No. of exchange telephones.	Miles of wire.	Capital stock.
1900	36,414	110,605	$ 7,000,000
1901	53,511	145,785	9,000,000
1902	79,043	195,020	11,993,400
1903	101,187	231,198	14,000,000
1904	117,893	253,088	14,000,000
1905	143,223	291,155	14,000,000
1906	170,834	358,986	14,000,000
1907	202,681	471,168	16,908,500
1908	231,180	550,445	27,000,000
1909	262,359	626,438	27,000,000

At the annual meeting Bernard E. Sunny, president of the company, commented upon this report as follows: "The net increase in the number of telephone stations for the year was 31,179. In 1899, after the company had been in operation for more than twenty years it had 27,663 telephone stations. The number of new telephone stations added in 1909 is therefore greater than the number accumulated in the twenty years up to and including 1899. The volume of traffic shows an improvement of almost fifteen per cent over 1908, owing to the improved general business conditions. At the close of the year we had 8,104 employes, and the amount paid during the year for salaries and wages amounted to $5,100,000."

William H. Miner was elected a director. The full board is as follows:

Arthur D. Wheeler, chairman; John M. Clark, D. Mark Cummings, Chauncey Keep, Robert T. Lincoln, Theodore W. Robinson, Byron L. Smith, Albert A. Sprague, Bernard E. Sunny, Theodore N. Vail, William H. Miner.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

INTERCOMMUNICATION IN THE HOSPITAL.

BY A. G. KINGMAN.

The necessity of a sure and effective means of intercommunication to weld together into an organized whole the various departments of a hospital has always been apparent. Instant access from the offices of the superintendent and other administrative officials to the house physician's headquarters, and connection at all times with sick wards, operating rooms, physicians' and nurses' quarters and reception room are details that make for the efficiency of the well-organized institution.

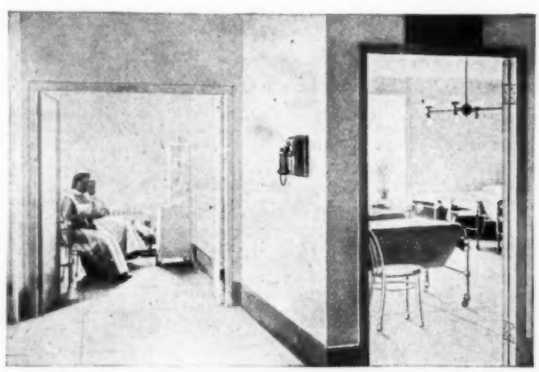
How one hospital solved this problem is illustrated by the accompanying photographs. Many hospitals today are using this automatic intercommunicating telephone system which requires no operator and brings all the departments of an establishment into immediate reach of each other.

The illustrations were secured at the Frederick A. Douglass Memorial Hospital in Philadelphia, a new $100,000 structure. This building is said to be the largest and best appointed, operated exclusively by colored people, in the world. The institution was founded in 1895 for the purpose of providing a training school of nursing for colored persons.

Provision was made for effective intercommunication when the original plans for the building were drawn up. The designing architect, E. F. Bertolett, specified the system of "interphones" manufactured by the Western Electric Company, the firm which makes all the telephones for the Bell companies. Instruments of the metal wall type are used at the Douglass Hospital. Communication is secured by means of a series of buttons, opposite each of which is a name plate for the guidance of the person wishing to use the telephone. Merely pressing the button opposite the name of the party desired gives the signal at the correct station. Securing the conversation is prompt and there is no chance for talk to go astray.

TELEPHONE OUTSIDE OF WARDS B AND C.

One of the illustrations shows a nurse at her station just outside the operating room. It is of course desirable that the instrument be not inside the room, but it is apparent that in the case of the Douglass Hospital the telephone is within instant access. In the other picture the instrument is directly outside the doors of Wards B and C, and nurses are seen ready to respond to any call. Thus the house physician from his station can receive advices from either the operating room or the sick ward; can consult with operating or attending physicians, direct nurses and attendants and answer inquiries from the outside. The work of the hospital is thus brought into a single businesslike organization.



TELEPHONE OUTSIDE OF OPERATING ROOM.

Prof. F. E. Turneaure Lectures at University of Illinois.

Dean F. E. Turneaure of the College of Mechanics and Engineering of the University of Wisconsin gave two addresses before the instructional staff of the College of Engineering of the University of Illinois on February 10 and 11. His subjects related to bridgework.

A TWENTY-SIX-TON REEL OF SUBMARINE CABLE.

BY ROBERT A. SHELLY.

The spectacle of twenty horses drawing a single reel of telegraph cable through the congested streets of a large city, is one that is not frequetly encountered. Such a coterie, however, recently passed through the streets of Brooklyn, N. Y., en route from the factory in which it was made to the cable dock of the Western Union Telegraph Company situated in Jersey City, N. J. This unusual sight is shown in Fig. 1. The task of transporting a single reel of cable weighing twenty-six tons is, in itself, a problem of considerable interest and importance, but as the cable is one of the largest single lengths of its type ever manufactured, the manufacturing details for obtaining the requisite mechanical and electrical properties present much interesting and valuable information.

All cables designed to distribute electrical energy must perform certain functions when in use. These functions are produced by the processes of manufacture, which have been evolved from time to time to meet the varying requirements arising from progress in the electrical art. To define or specify the processes of manufacture, the exact uses to which a cable is to be put must be known.

The operating company and the man-

ufacturer share in the honors for the production of the present day electrical cables. One of the foremost companies in this respect is the Western Union Telegraph Company, and the manner in which its specifications have been generally adopted is evidence enough of their value and efficiency in procuring a high-class product. The cable to be described and which is herewith illustrated was made in accordance with the Western Union specifications for a twenty-five-pair dry core submarine cable.

The cable was manufactured by the Waterbury Company, of New York city. Although the cable, as seen in Fig. 2, which is a full-size view, is two and one-half inches in diameter, and of extremely heavy construction, it was necessary to make it in one continuous length of 5,280 feet. This was necessary to avoid splices in laying the cable between the two points for which it was intended, which are approximately one mile apart. The specifications referred to are unusually severe for submarine service, and the important details are as follows:

FIG. 1.—TWENTY-SIX-TON REEL BEING MOVED FROM FACTORY.

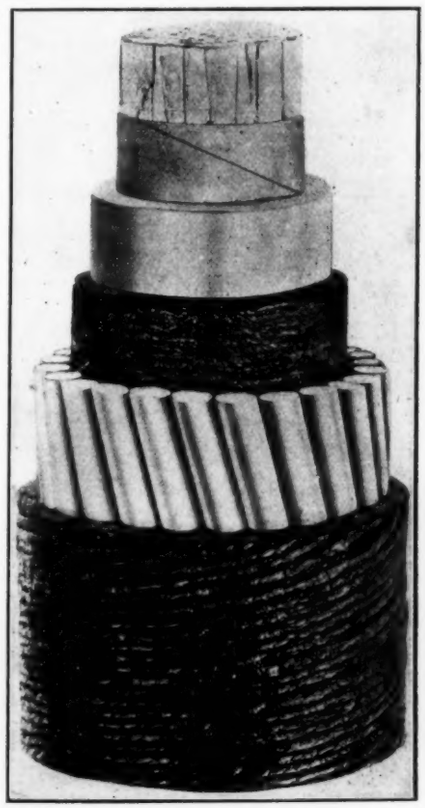


FIG. 2.—FULL SIZE VIEW OF CABLE.

The cable consists of twenty-five pairs of No. 14 B & S copper wires, having a conductivity equal to ninety-eight per cent of that of pure copper. Each conductor is insulated with three wrappings of special insulating paper, and the conductors are paired with a twist of six inches. The pairs are laid up into a core in accordance with the lay-up diagram furnished with the specifications, each layer containing a distinctly colored pair which serves as a tracer for that layer. The core is covered with three wrappings of special heavy paper over all.

The complete core after being thoroughly dried out was covered with a sheath of pure lead three-sixteenths of an inch in thickness. As the life of all dry-core cables, and especially that for submarine service, is dependent upon the integrity of the lead sheath, the lead cable was tested upon completion of this operation in the manufacture, after the entire cable had been immersed in a testing tank of water for twenty-four hours.

The mechanical and electrical properties of the lead-covered cable being satisfactory at this point in the manufacture, the operation of applying the armor was begun. To protect the lead sheath and serve as a bedding for the armor wires three reversed servings of soft jute roving, saturated with tar compound, were first applied to the cable. Upon this bedding, twenty-three No. 4 B. W. G. galvanized steel armor wires were laid up. Upon the armor wires two reversed servings of hard twisted jute yarn saturated with a preserving compound were placed. The operations of applying the bedding, the armor wires and the final covering of jute yarn were carried on simultaneously.

To complete the cable it was given a coating of whitewash, which was effected by placing the capstan or pull-off wheel of the armoring machine in a bath of whitewash. This was applied continuously as the completed cable came from the armoring machine, and is intended to keep the layers of cable, when on the reel, from sticking to each other due to the cohesion of the jute yarn with its preservative compound.

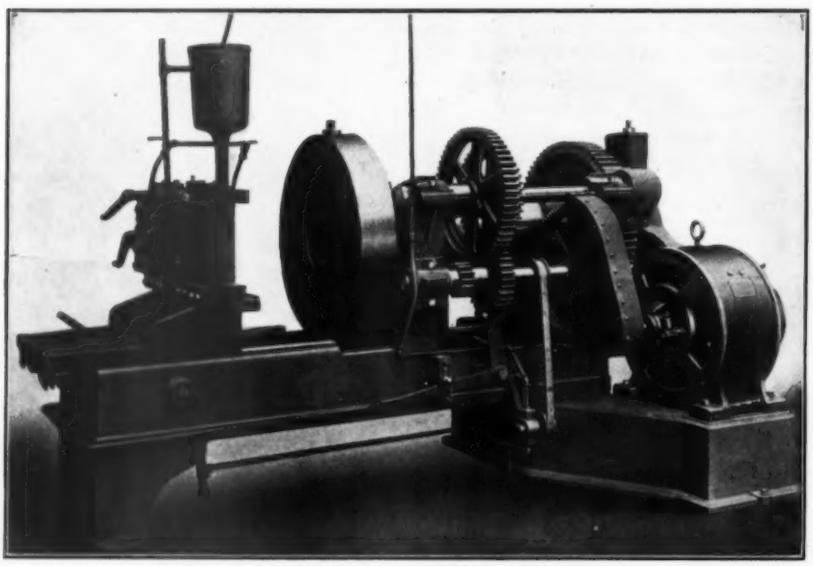
The final test on the cable was made by the inspector for the Western Union Telegraph Company after the completed cable had been submerged in water for twenty-four hours. An expedient was resorted to at this point in the process which avoided the moving of the twenty-six-ton reel of cable to the testing tank maintained for that purpose. A piece of sail cloth was wound around the reel in such a way as to form a reservoir. This was then filled with water until the cable was completely submerged and allowed to stand the required time.

The final inspection covered the examination into the mechanical details and measurements, together with tests of the electrical properties which included a test for insulation resistance, specified to be not less than 500 megohms per mile, and a test for electrostatic capacity, specified to be not more than 0.095 microfarad per mile. The final electrical test was for dielectric strength, using a potential of 2,000 volts applied between each conductor and all of the others, and between all of the conductors and ground. The results of these tests in all instances were entirely satisfactory.

Large Pipe Threader Driven by Adjustable Speed Motor.

In securing economy and rapidity of production in many machine tool operations, the individual adjustable speed motor has many advantages over other methods of drive.

The older methods of speed variation, cone pulleys or gear reductions, provide only compartively large, rough changes in speed. On the other hand, the adjustable speed motor makes possible fine gradations in the working rate of the tool driven, enabling it to be worked at all times at the proper speed to insure operation of its productive capacity. In many cases it is said the avoidance of expensive and cumbersome speed changing apparatus, following the use of the adjustable speed motor, has resulted in reducing the cost of the tool taken complete with its adjustable speed motor, aside from the items of increased convenience and improved operation.



PIPE THREADER DRIVEN BY ADJUSTABLE SPEED MOTOR.

The accompanying illustration shows a Westinghouse type SA adjustable speed direct-current motor driving a machine for cutting and threading pipe from 2.5 inches to eight inches in diameter, built by the Cox & Sons Company, Philadelphia, Pa. These machines are designed in sizes to handle pipes up to eighteen inches, internal diameter, and the special motor drive supplied has proved satisfactory. Where quick changes in speed may be required, as in small shops handling a number of different sizes of pipe, such changes can be most easily made with the adjustable speed drive; saving the time lost in shifting gears or belts, and bringing the machine promptly to its most efficient cutting rate. As seen from the illustration, the pipe threader is provided with one set of gear changes, and has an oil system which keeps the cutting tool well flooded with oil.

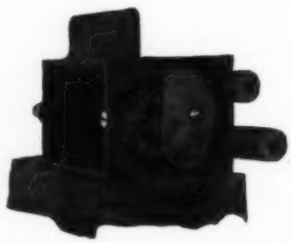


FIG. 1.—NEWHUB SWITCH BOX.

Newhub Wiring Devices.

The Newhub Electric Company, 227 West Exchange Street, Akron, Ohio, is placing on the market two new electric wiring devices which are meeting with favor on account of their simplicity of construction and their usefulness.

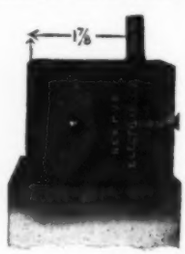


FIG. 2.—INSTALLATION OF SWITCH BOX IN PARTITION.

The Newhub switch box, shown in Fig. 1, may be conveniently attached directly to the studding, saving the time and labor otherwise required to fasten it up with boards. Any number of these switch boxes may be attached to the studding, one above the other for tandem plates. The use of the spacing tool will accurately adjust them so that all the switches may be covered by one tandem plate. In Fig. 2 is shown a Newhub switch box used in partition one and seven-eighths inches deep.

The outlet bracket shown in Fig. 3 is designed for knob and tube work and on account of its many uses is becoming very popular. The bracket may be conveniently attached directly to the joists or studding where outlets are desired for switches and lights, saving time and labor otherwise required to fit boards. These brackets make the mounting of the various wiring devices easy. It is also claimed that the amount of flexible conduit and labor saved often equals the cost of the bracket. In Fig. 4 is shown a Newhub outlet bracket attached directly to a joist.

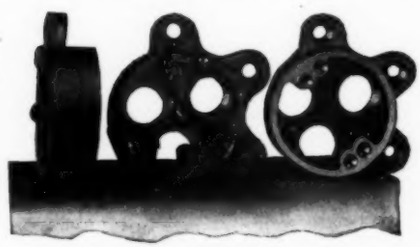


FIG. 3.—VIEWS OF NEWHUB OUTLET BRACKETS.

FIG. 4.—OUTLET BRACKET ATTACHED TO A JOIST.

Wireless Stations in Russia.

Contracts have been let by the Russian Government for eight-kilowatt wireless stations on the Telefunken system at Petropavlovski in Kamchatka, and Nikolaievsk.

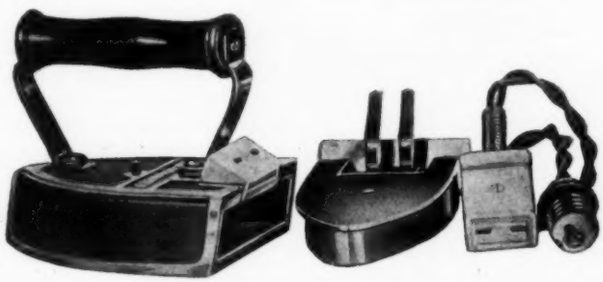
The Guaranteed Electric Flatiron.

Those who are interested in the development of the electric flatiron will find an attractive article in the Guaranteed electric iron, shown in the accompanying illustration. This iron, which is meeting with much success, is being placed on the market by the Guaranty Electric Heater Company, Cleveland, Ohio, and in the construction of this new model many features have been improved upon.

The heating element, the most important part of any electric iron, is unique in this iron, in that the resistance material is not made of wire and will therefore not corrode or disintegrate. It is also very easily removed by simply loosening the screw in the center of the top of the iron. This allows the operator to install or remove an element with little or no trouble and a unit suitable for the work in hand may always be used.

The contacts and contact plugs are made large and strong, thereby insuring durability. The porcelain plug is substituted for one made of an asbestos composition. The conductor cord is knotted inside the plug so that pulling on the cord will not sever the electrical connection. The whole iron is rigidly constructed and will stand wear and tear.

All irons of this company are sold under a guarantee and warranty bond, furnished with each iron in the form of a mailing card, which guarantees the iron for a year. Any defective part will be replaced by merely sending the above-mentioned post-card to the company mentioning the defective part, or parts, of the iron.



PARTS OF GUARANTEED IRON.

Copper Exports.

Exports of copper for the week ended February 3 were 8,815 tons. Since February 1 they were 5,332 tons, compared with 2,192 tons the same period last year.

Field Rheostats Designed for Remote Control.

Electric power plants, representing the expenditure of large sums of money, are striving to make their installations attractive. Electrical apparatus, from its feature of remote control, in general, admits of installation anywhere and control from any point. The switchboard, with its polished marble panels, is a part of the installation which is capable of design so as to be very pleasing in appearance. Its attractiveness is enhanced by the absence of cumbersome apparatus and the lack of crowded confusion that results from installing on it all the apparatus to which the operator must have quick and easy access.

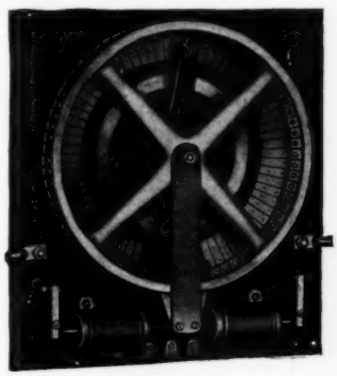


FIG. 1.—RATCHET-DRIVEN FIELD-RHEOSTAT SWITCH.

One of the troublesome problems, however, in the design of switchboards has been that of finding a place for the large generator field rheostats. The General Electric Company has apparently solved this problem by designing a rheostat, the type CR 179, which admits of remote control, the controlling switch only being located on the switchboard, while the rheostat itself is installed at any point where convenience and economy of space may dictate.

The details of its construction and the manner of operating it are clearly shown in Figs. 1 and 2. The rheostat arm is rigidly fastened to a wheel with a toothed rim. Pawls fastened to the common core of the two magnets *AA*, Fig. 2, engage the toothed rim of the wheel mentioned above and move it clock-wise or counter clock-wise.

To cut resistance into the field, it is only necessary to close the double pole switch *B* to the left, thus energizing the left-hand solenoid and causing the left-hand pawl to engage the rim of the wheel, moving it in a clock-wise direction.

When the solenoid core has reached its extreme point of travel, the solenoid circuit is automatically opened by the small switch *C*, allowing the pawl to be returned to the position midway between the solenoids by a spring, and permitting the switch *C* to again close, starting anew the cycle of operations just described. This cycle of operation is repeated over and over again until switch *B* is opened.

To cut out resistance switch *B* is closed to the right, causing the same cycle of operations as described above, with the exception that the right-hand solenoid is energized and the arm is driven counter clock-wise.

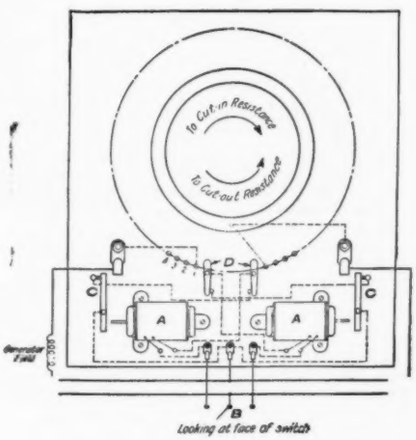


FIG. 2.—CONNECTIONS OF SWITCH.

Each end of the switch dial is provided with a limit switch *D*, which is automatically operated by the switch arm to open the circuit of the solenoid when the resistance is entirely cut in or out, protecting the apparatus in case the solenoid is left energized when the arm has reached its extreme point of travel.

There are no high-speed revolving parts which, due to their inertia, continue to cut in resistance after the controlling circuit has been opened.

Notable Mazda Installation.

The largest individual installation of Mazda lamps in Indianapolis is the new store of D. Sommers Company, where 5,070 Buckeye lamps of the latest type have been installed. Of this number 3,700 are forty and sixty watt lamps and 1,370 are sign lamps. The illuminating effect is remarkably brilliant, the wattage being easily double what would ordinarily be used in order that the name "The Daylight Store" might be sustained after dark. A roof sign eighty feet long and forty feet high contains the firm name and a clock outlined in lamps. Twenty-one eight-foot letters are used in the sign, which requires 1,370 Mazda lamps and five compensating transformers.

The installation is on the circuits of the Merchant's Light and Heat Company making it an excellent advertisement for the lighting company.

INSTALLATION OF BUCKEYE LAMPS.

New Buildings for the F. Bissell Company.

The enormous growth of the F. Bissell Company, of Toledo, Ohio, has made considerable enlargement of plant capacity necessary, and with a view of meeting a still further increase of business the company has just purchased an entire city block upon which to erect new buildings.

A warehouse to be used for the storage of electric light and telephone poles, cross-arms and pins, will be erected as soon as the contract can be awarded. Other bulky merchandise manufactured by the company will also be stored in this building.

At some later time, probably in the Spring, the company will erect a big machine shop to manufacture generators and motors, and supplies for the telephone, telegraph and lighting industries. Switchboards will also be built in this shop.

When the new buildings are completed, the company will abandon the several buildings scattered about the city and center its operations at the new location. The Huron Street store will, however, be retained.

The Hagstrom Semi-Automatic Cord Adjuster.

The Hagstrom Brothers Manufacturing Company, of Lindsborg, Kan., has recently placed on the market a semi-automatic cord adjuster for regulating the length of cord in the case of a single hanging lamp. This adjuster may be easily placed on any lamp cord and affords a much better means of lowering or raising a light than did the old, unsightly cord adjusters.

HAGSTROM CORD ADJUSTER.

The lamp cord, passing through the adjuster, is wrapped around a wooden spool, which is actuated by a coiled steel sprig, so that the cord length is automatically shortened when the spring is released by touching a button. The cord is lengthened by simply pulling against the resistance of the spring.

In addition to the fact that the adjuster is very neat in appearance, it is easily taken apart to provide for the insertion of a new lamp cord when the old one becomes worn.

Electrical Glassware in Structural Forms.

During the recent Chicago Electrical Show, the Macbeth-Evans Glass Company, Pittsburg, Pa., exhibited for the first time its beautiful white Alba glass arranged in structural forms. In the center of the booth was a table draped in black velvet supporting six pillars which in turn held two plate glass shelves, each being capped with a ball of the same material as the pillars.

Inside the columnar sections were Linolite lamps and the light from them gave the glass columns the appearance of softly glowing white marble, the effect being very pleasing to the eye. The hollow sections, arranged in the forms of columns, were about four inches in diameter, the glass being about one-half inch thick.

The exhibit also contained many different shapes of the newer lines of decorative glassware manufactured by this company such as leaded goods in Mission and Old Dutch styles mingling with the more showy pieces made from Bournique glass, also a number of portable lamps, reflectors, etc. However, the display of Alba glass in structural forms was the most conspicuous feature and attracted the most attention. A photograph of this exhibit was shown in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN for February 5, page 295.

Westinghouse Company's Business.

The improved business conditions at the East Pittsburg shops of the Westinghouse Electric and Manufacturing Company, which have manifested themselves particularly since last fall are continuing in all departments. During January the orders again were nearly $3,000,000. In the railway department five orders were received from as many companies, aggregating 1,200 railway motors, approximating a capacity of 60,000 horsepower. In the detail and supply department the production has increased to a remarkable extent, the demand for this type of Westinghouse manufacture having become more general than ever. The shops at Newark, N. J., are now turning out 30,000 electric motors every month, while the indications for this year's fan-motor production are already showing up so large as to make the outlook for an enormous business in that line during the coming season a safe prediction.

Current Electrical News

GREAT BRITAIN.

(Special Correspondence.)

LONDON, JANUARY 28.—The courts have been very busy of late with electrical cases. The hearing of the petition for the revocation of the Bremer flame arc lamp patent, owned by the British Westinghouse Company, has been argued before the Court of Appeal, judgment being reserved. The Westinghouse Company took action against a Mr. G. Braulik for infringement of the patent, and the defense set up was that Bremer had been anticipated in an American specification of Graham in 1882. This plea was successful in the Chancery Court and the Bremer patent was held to be invalid. It is this decision which has been appealed against.

Another action of some interest on the other side of the Atlantic, is one by Messrs. J. H. Holmes & Company, of Newcastle, against the Associated Newspapers, Limited, on the ground that certain electrically controlled printing machines in the office of the London Evening News, which are equipped on the Kohler system, are an infringement of the Holmes patent for a similar purpose. Here again, it is an American patent which it is claimed anticipates the English patent. In this case, the Court of Appeal has upheld the decision of the Chancery Court that the publication of a description of a printing press controlled electrically, and which was published in *The Western Electrician* in the eighties, constitutes anticipation. Another important patent action is proceeding concerning patents for electrically-driven reversing rolling mills, in which Messrs. Siemens Brothers are suing the Electric Construction Company. The case promises to be a lengthy one, some seven expert witnesses having been retained.

Discussion is being carried on at all the local sections of the Institution of Electrical Engineers concerning the price which should be charged for tramway energy. The point debated is as to the proper allocation of the fixed and running charges in order to arrive at the proper charge for tramways. A new principle has been enunciated by Mr. J. F. C. Snell, late borough electrical engineer and tramways manager at Sunderland, which appears to find favor with a large number of people. He takes the ascertained maximum demand of the tramways and then finds the coincident maximum demand, i. e., the demand of the tramways at the time of the maximum peak upon the whole station. He takes the mean of the figures and arrives at the fixed charge by taking the capital charges, management—less cost of distribution department—rent, rates, taxes and insurance, and wages at the powerhouse and substation. He divides these fixed charges by the total demand in kilowatts, i. e., the mean as described above, and multiplies the resultant by the ascertained demand of the tramways. This gives the proportion of the fixed charges which the tramways should pay. In order to arrive at the running charges, he divides the number of units delivered to the switchboard by the working expenses, and multiplies this figure by the number of units delivered to the tramways, in order to get the total charge for energy, i. e., the total running charges. In addition, Mr. Snell would allow from five to seven and one-half per cent for profit, as the above calculations give the cost price. G.

CONTINENTAL EUROPE.

(Special Correspondence)

PARIS, February 4.—Owing to the great rise of the Seine, a number of electric plants have been flooded, and among these is the Metropolitan station which lies adjacent to the river. It has several feet of water and the powerful pumps are working in vain to remove it. Several sections of the subway line have been obliged to stop running, as the tunnel is flooded in many places, and the work on the North-South subway is entirely stopped over a large part, as the water has backed up in the tunnel for quite a distance thus reaching even the St. Lazare depot in the heart of town. The electric section of the Orleans railroad and also a number of electric tramway lines have also ceased to run. Current for the Metropolitan subway is, however furnished by the St. Denis plant, so that there is no difficulty from lack of current and trains are run as usual upon many sections. The city mains have also suffered in many places, as have the telephone and telegraph underground lines, many of which run in the large sewers, so that there are about 5,000 telephone subscribers cut out at present.

A syndicate located at Trieste, Austria, has lately been granted the rights for an electric railroad line running from the commune of Strugnano to Porto Rose. A concession has also been granted to another firm for a narrow-gauge line which is to be built between Zarubek, a station on the Mähr-Karwin railroad, and the town of Klein. Among other Austrian projects I note a new electric railroad to be run from the railroad station of Klosterneuberg to Gugging. The Budapest Traction company has lately obtained the rights for a suburban railroad running to the locality of Csepel. The question of the electric lighting of the principal streets is occupying the attentions of the Municipal Council of Budapest. For the arc lighting it is proposed to erect a third and separate electric plant which will be used exclusively for the purpose.

Referring to the question of using the sources of the Valturno for a power supply for Naples, it is proposed to bring the 45,000 volt three-phase line into town to a substation which contains step-down transformers, so as to work at 6,000 volts on the mains. There are to be three principal circuits for the city and suburbs which the substation will supply. For the suburbs several pole lines will be used, but within the city the mains will run in underground cable. In connection with the substation it is proposed to build a steam plant having an output of 6,000 horse power, and this added to the capacity of the power plant will give about 16,000 horse power, for the city use.

In Russia, there is a project on foot for the electric lighting of the town of Halsbstat, in the Tauris region. Zeven, Germany, is taking measures to erect a light and power station.

During the Brussels Exposition there is to be held a congress of tramways and light railroads under the auspices of the International Tramway Union, from September 7, 1910. The subjects to be treated on this occasion will include the use of gas and oil engines in generating stations, current meters upon cars, overhead lines, etc.

A business agreement has been made between Schneider & Co., who operate the large machine works at Crensot, France, and the German firm of Felten-Guilleaume-Lahmeyer of Mulheim. The two companies will now execute large orders for electric material in common, at least in many cases. The turbine manufacturing firm of Escher-Wyss et Cie of Switzerland has also made an arrangement with the above firms as regards the construction of the Zoelly turbine, which is now extensively manufactured by the Swiss firm.

In Russia the Moscow-Kasar Railroad Company expects to construct four new branches of electric road in order to increase the existing system of lines.

A turbine plant is to be built on the Poprad River, Hungary, at the locality of Eperjes. It will use a 100-meter fall and will probably give 10,000 horsepower. A. DE C.

EASTERN CANADA.

(Special Correspondence.)

OTTAWA, ONT., February 12.—It is understood that the Canadian Light and Power Company, of Montreal, hitherto known as the Robert Syndicate, expects to be delivering power in Montreal before the close of the current year.

The city of Berlin, Ont., owns its electric street railway, its electric light plant and its water works plant. Last year these paid a profit to the city of $26,000 after certain of the rates had been reduced below the figures asked in neighboring towns for similar service.

The gross revenue of the Toronto Electric Light Company showed an increase last year of $137,000, and the reserve now exceeds $1,000,000. There was a large increase in the number of customers during the year. It was announced that a reduction of prices would take place in the new scale now being prepared.

The manager of the Canadian General Electric Company states that it is the intention of the company to spend between $250,000 and $750,000 on new buildings and equipment, but beyond that nothing definite has as yet been decided upon. The company has on hand, at the present time, orders for machines totaling 100,000 horsepower.

The council for the town of Galt, Ont., has decided that the purchase price of $85,000, asked by the Galt Gas Light Company, which owns and operates the electric light plant in the town, is too much for the plant, as it exceeds the engineer's estimate by $32,000. The council proposes now to buy the company's poles and wires, worth $10,000, for $12,000, to be used for the transmission of Niagara power, and the council declines to arbitrate, not being bound to do so. The situation thus developed is somewhat awkward for the existing company, which will either have to compete with hydroelectric energy or else go out of business.

Application is being made to Dominion parliament for the incorporation of "The Ottawa, Rideau Valley & Brockville Railway Company," with power to construct and operate an electric line between Ottawa and Brockville; a ferry across the St. Lawrence River at Brockville, and a line between Ottawa and High Falls, Que. The company seeks authority also to develop and transmit electricity for power, heat and light purposes. Electric energy will be generated at various points along the line of the proposed railway.

Reports submitted at the annual meeting of the Ottawa Electric Railway Company shows the past year to have been exceedingly prosperous for the company. The net profits for the year were $247,285, out of which dividends amounting to twelve per cent were paid. The net earnings were equal to a fraction below twenty per cent earned on the capital stock. The company requires more hydraulic power, and the question of duplicating the present waterpower house is being considered. In 1892 the number of passengers carried by the street railway was 1,500,000, while last year the road carried 14,983,799 passengers. The old board of directors was reelected, with T. Ahearn, president.

A big scheme of power development is involved in a bill to be laid before Dominion parliament incorporating the Ottawa & Montreal Power Transmission Company. By this bill power is sought to acquire, create and transmit hydraulic, pneumatic, electric and other power, in the counties of Wright and Pontiac, and to transmit it to Montreal. A provision in the bill, empowering the company to cross the Ottawa River, southerly, will also enable it to supply the power demand in Ottawa and in other localities. The original capitalization is placed at $500,000, but power is sought to increase it from time to time, and the names of the incorporators themselves are equivalent to a guarantee of millions. The company has a considerable development already, and other water powers awaiting development. It is intended to acquire additional water powers and develop them as the demand for electric energy increases. Power transmission lines will be built through the counties of Wright, Labelle, Argenteuil, Two Mountains and Laval to the city of Montreal, and the company will construct branch lines to towns on either side of the Ottawa River. W.

IMPORTANT DEVELOPMENTS.

TO DEVELOP POWER SITES.—Another large company to develop power sites in central Washington has been organized by Robert E. Strahorn, builder of the North Coast Railway, and associates. It is the Columbia River Reclamation Company, with headquarters in Spokane. Mr. Strahorn's name does not appear in the incorporation papers of the company, although it is known that he is largely interested, and one of the inspiring forces of the new organization. The new company has filed a request for a right-of-way across state lands, near Priest Rapids, Ida., for a width of 1,000 feet and running about ten miles near the river. While the capital stock is only $100,000, it is generally understood that the company has been fully financed. Mr. Strahorn now controls all the power in Yakima Valley except that at Ellensburg and Prosser, where there are small plants.

POWER FROM THE SAVANNAH RIVER.—Excavation for the powerhouse which is to be erected on the Savannah River near Augusta, Ga., are now being made. A railroad has been built from Modoc, S. C., to the dam site in order to facilitate the work of excavation. The Ambursen Hydraulic Construction Company of New York city has the contract for building both dam and power house. The work represents an investment of $3,000,000, and according to the terms of the contract, power must be delivered to Augusta within three years. B.

AN ELECTRICALLY-DRIVEN TEXTILE MILL.—An option has been secured on a large tract in the state of North Carolina whereon it is understood that a million-dollar textile manufacturing plant, to be electrically driven, will be erected soon by New York and Boston capital. W. Jordan Massee, president of the Central Georgia Power Company, is a stockholder in the new enterprise, which will cost about $650,000. The electrical development on the Ocmulgee river is progressing rapidly and 20,000 horsepower of electric energy will soon be available. The proposed cotton mill is said to be the first industrial enterprise to follow the harnessing of the Ocmulgee river. L.

LIGHTING AND POWER.

(Special Correspondence.)

SIDNEY, NEB.—The Sidney Electric Service Company has increased its capital stock to $50,000. P.

LOS ANGELES, CAL.—A committee has completed plans for the street lighting system of Pomona. A.

PLAINVIEW, TEX.—The Malone Light and Ice Company has been incorporated with a capital stock of $30,000.

GRAND FORKS, N. D.—This city will vote on a bond issue of $25,000 for the construction of an electric light plant.

GILBERT, MINN.—A vote is to be taken on issuing bonds for $15,000 for improvements in the light and water systems. C.

FLORENCE, ORE.—T. J. Monroe, of Coos Bay, has applied to the city council for a franchise for an electric light plant. A.

FAIRFAX, MINN.—It is proposed to take a vote on issuing bonds for $5,000 for the installation of an electric light system. C.

APPLETON, WIS.—The Wisconsin Traction, Light, Heat and Power Company will double its steam plant at the power house. C.

GREAT FALLS, MONT.—It is proposed to bond the city for $200,000 for the construction of a dam and electric power plant. C.

DANBURY, CONN.—The Danbury & Bethel Electric Light Company has filed a certificate increasing its capital stock to $300,000.

GRAND RAPIDS, WIS.—The Consolidated Water Power and Paper Company is installing a new 600-kilowatt alternating-current generator at its plant. It will furnish the town with light M.

CROCKETT, TEX.—The Crockett Ice, Electric Light and Power Company has recently been incorporated with a capital of $10,000. P.

PORTLAND ORE.—The Bandon Light and Power Company will double its present capacity and will put in two miles of new line. A.

LIDGERWOOD, N. D.—The Lidgerwood Mill Company has applied to the council for a franchise to install an electric lighting plant. C.

SPANGLER, TEX.—The Spangler Light, Heat and Power Company has been granted a charter. The company has a capital of $5,000.

HATFIELD, WIS.—The La Crosse Water Power Company, of La Crosse, Wis., will erect a dam across the mouth of Rock Creek. C.

MONTICELLO, IND.—The Tippecanoe Hydroelectric Power Company is in the market for the installation of an additional generator. S.

HARTWICK, PA.—The Hartwick Power Company has been incorporated with a capital of $100,000 to furnish light and power for this city.

TACOMA, WASH.—The Cameron Electric Company has been awarded the contract for furnishing Tacoma with $25,000 worth of electric lamps. A.

BESSEMER, ALA.—This city contemplates the erection of a lighting plant. This may be of 500-kilowatt capacity; Wm. Hugh McEnery is city engineer. B.

NORTH SMITHFIELD, R. I.—The contract with the Woonsocket Electric Company has gone into effect, and the streets of this town are now lighted by electricity.

WILSON, N. C.—The new plant of the Contentnea Guano Company, one of the largest in the state, will be operated by electric power supplied by the city electric plant. L.

OTSEGO, MICH.—W. A. Foote, of Jackson, has purchased the power of the Otsego Light and Power Company. The sale includes the real estate and 544 inches waterpower.

NORTHFIELD, MINN.—The plant of the Northfield Light, Heat and Power Company has been transferred to the Cannon Valley Electric Company, and will be much improved. C.

ELWOOD, IND.—The City Council is open for bids on propositions to light the streets for a term of ten years. One hundred or more lamps of 2,000 candlepower will be required. S.

BLOOMINGTON, IND.—The Showers Brothers Company is in the market for the purchase of 400-horsepower boilers, engines, generators, heater, pump, switchboard and motors. S.

COLUMBUS JUNCTION, IOWA.—The industrial committee of the Commercial Association is investigating the possibility of constructing a dam across the Cedar River to secure power. C.

EVANSVILLE, IND.—The city council has granted a franchise to the Evansville Gas and Electric Light Company for the construction, equipment and operation of a new plant to furnish heat and light. S.

ROCHESTER, MINN.—The Rochester Light, Heat and Power Company has succeeded the Rochester Light and Fuel Company. The company expects to make gas and electricity and will enlarge the plant. C.

WEST BOYLSTON, MASS.—The contract for the construction of the electric light plant has been awarded to the Delta Electric Company, of Worcester, whose bid was $13,479. Work will begin immediately.

SENOIA, GA.—Senoia Electric Light and Power Company, which was recently incorporated, has organized by electing W. B. Baggarly president, H. L. Ware vice-president, and H. P. Redwune secretary and treasurer.

POTTSVILLE, PA.—Plans for the equipment of the Bear Valley and the Burnside collieries, in the Shamokin district, with electric power and light are completed by Electrical Engineer Jennings, of the Coal and Iron Company.

ELGIN, TEX.—Thos. L. Deisch, of Helena, Ark., has secured a franchise from the city for twenty-five years to erect a $14,000 electric light plant. The operating company will be known as the Elgin Light and Power Company.

TOMBSTONE, ARIZ.—The new Prescott Electric Company's plant at Prescott has been connected with the Arizona Power Company's works on Fossil creek and a new era in power and lighting for the city has been established.

WEST NEWTON, PA.—The state department has granted a charter to the West Newton Electric Company at West Newton, with a capital of $5,000. The incorporators are: A. E. DuBois, C. W. Scheck and Byron Tribule, Pittsburg.

MIDDLETOWN, ILL.—The Johnson Valley Coal and Light Company has incorporated with a capital of $10,000 to mine and sell coal and to generate and sell electric power. The incorporators are C. F. Johnson, E. L. Beebe and H. C. Johnson.

LOS ANGELES, CAL.—Trustees of Hermosa Beach have

closed a contract with the Edison Company, calling for an expenditure of about $250,000, for the installation of arc lights on all thoroughfares where street work is in progress. A.

LOUISVILLE, KY.—At a special meeting of the stockholders of the Louisville Lighting Company the proposed issue of preferred stock to the amount of $1,150,000, and the proposed issue of $1,000,000 of convertible thirty-year six per cent gold bonds were approved.

NORTH BALTIMORE, O.—The electric plant in this city will probably be turned over to Cleveland interests in a short time. Clark A. Browning, of Toledo, who is heavily interested in the property will be prominent in the reorganization. A new franchise will be asked for.

INDIANAPOLIS, IND.—The Merchants' Heat and Light Company has completed the installation of a number of ornamental lights in Washington Street. The company has also contracted to furnish similar lights around the State House square and to light the State House for one year. S.

NORTHUMBERLAND, PA.—It is reported that the Pennsylvania Railroad Company is planning the erection of a $500,000 electric lighting and power plant here. The plant will furnish all the power for the railroad shops at Sunbury and will furnish light for the shops, yards and station.

WINNIPEG, MAN.—In an action brought by the city to enjoin the Winnipeg Electric Company from distributing electricity for light and power purposes without having obtained the consent of the city by a by-law, a decision has been rendered in favor of the city. It is understood that the company will appeal. C.

SYRACUSE, N. Y.—The Public Service Commission has authorized the Oswego River Power Transmission Company to execute bonds to the amount of $100,000. Substations will be built at Baldwinsville and Fulton, and the power lines will be extended. The company was incorporated in 1905 with a capital of $20,500.

EAU CLAIRE, WIS.—The Chippewa Valley Railway Light & Power Company let the contract to the Amberson Company, of Boston, for the construction of a dam and power station at Cedar Falls on the Red Cedar River. The construction will cost $300,000 and the equipment $200,000 more. Eight thousand horsepower will be developed. C.

ROANOKE, IND.—The Ft. Wayne & Wabash Valley Traction Company is now furnishing current for lighting this town. This is said to be a first step toward extensive development of lighting towns and cities along the company's line. Delphi, the county seat of Carroll County, will be the next town to be lighted by the traction company. S.

EVANSVILLE, IND.—The Evansville Public Service Company has begun work on the construction of a new plant in which about 2,400 horsepower in water tube boilers will be installed, as well as all the auxiliaries of a modern electric generating station. Steam turbines will probably be used. No contract for machinery has been awarded as yet. S.

ASHEVILLE, N. C.—The splash dams have been located for the $400,000 hydroelectric development on the French-Broad River, two miles from Marshall, and as soon as weather conditions permit, active work on the dam will be begun. This work is being done by the W. T. Weaver Power Company, and many thousand horsepower will be developed. L.

EASLEY, S. C.—President J. M. Greer, of the Easley cotton mills, has signed a contract with the Southern Power Company for 250 horsepower, or more, to supplement the present power facilities for operating the mills and also to light the mill village. A transmission line will be built from Greenville to Easley to carry the current contracted for. L.

OAKLAND, CAL.—The People's Electric Light and Power Company has filed notice of intention to incur a bonded indebtedness of $250,000. This concern was recently incorporated, with $500,000 capital supposedly to compete with the Suburban Electric Light and Power Company which supplies light and power to Hayward and other cities.

AUBURN, IND.—Bids will be received for material and labor by the DeKalb Fuel, Light and Power Company for extensive improvements and additions to the plant in Auburn, Garrett and Kendallville. The entire plant operated by the company in these cities will come in for a general improvement. George L. Dunbar is general manager of the company. S.

INDIANAPOLIS, IND.—Twelve new shop buildings will be added to the seven buildings in operation at the Big Four shops at Beach Grove. Among these will be a power house 148x161 feet to be equipped with electric appliances and generators. The company will expend a million dollars in the construction and equipment of the new shop buildings. S.

ROCHESTER, N. Y.—The Rochester Light, Heat and Power Company has been organized at Rochester by Chicago capitalists, to take over the stock and property of the Rochester Lighting Company. The new owners intend to enlarge and improve the gas and power plants and thus give much better service to the city. The new concern is capitalized at $200,000.

ALBANY, N. Y.—A bill has been passed by the senate and assembly appropriating $5,000 for the acquisition of a site and the erection of suitable buildings for a powerhouse. This plant is to be used for lighting and heating the capitol and the new educational building. The bills introduced, provide for entering into contracts to the extent of $500,000.

PROVIDENCE, R. I.—The Narragansett Electric Lighting Company, at its annual meeting added four members to its board of directors, making the new board number nineteen. The board elected Howard O. Sturges a Vice President in addition to re-electing Arthur H. Watson. The new members of the board are Richard A. Robertson, Walter K. Sturges, Howard L. Clark and Arthur B. Lisle.

KALAMAZOO, MICH.—J. B. Foote, general manager of the Commonwealth Power Company, announces that during the present year the company will erect in Kalamazoo one of the largest power plants in the state. The plant will be a steam plant and from it power for the Michigan United Railways company will be furnished, as well as the power and light for Kalamazoo, Battle Creek and a number of small towns.

ARCHIBALD, PA.—As the result of a recent merger the Forest City Electric Company, the Lackawana Electric Company of Carbondale, the Crescent Electric Company of Archbald and the Standard Electric Company of Avoca will operate under the name of the Scranton Electric Company. The latter company has been operating the other companies for some time, and the chief object of the merger was to simplify book-keeping.

ATLANTA, GA.—It is stated authoritatively that the contract for the construction of the power development on the Etowah River near Creighton, Ga., for the Blue Ridge Power Company, has been secured by Frank D. Gilbreth, Inc., 60 Broadway, New York, N. Y. The work will include the work of constructing of a Ranson Hollow dam forty-two feet high and 600 feet long and a re-inforced concrete powerhouse sufficient for 4,000 horsepower installed. B.

THOMASVILLE, N. C.—The Thomasville Light and Power Company has contracted with the Southern Power Company to distribute power in Thomasville and maintain the substation. The Southern Power Company is now building a 4,000-horsepower substation which the Thomasville Light and Power Company will have charge of. The plant at this place will be equipped with automatic regulators.

LACONIA, N. H.—Negotiations have been concluded for the transfer of the control and management of the Laconia Electric Lighting Company to new interests. The board of directors has been reorganized by the choice of Wallace L. Mason and George M. Rossman of Keene and Allen Hollis of Concord, who represent the new purchasers. Mr. Rossman has been elected treasurer and Edmund Little of Laconia remains on the board, and has been chosen as vice-president.

MINNEAPOLIS, MINN.—The General Electric Company will expend $775,000 in improvements and extensions, including addition to the Taylor's Falls as follows: Plants and lines from Taylor's Falls, $400,000; short extensions, $150,000; underground work, $70,000; remodeling sub-station A, $50,000; rebuilding Garfield avenue station, $25,000; lines from Main street to sub-station A, $30,000, and additional feeder lines, $30,000. Two additional turbine wheels will be installed at Taylor's Falls. C.

BATAVIA, N. Y.—At a meeting of the stockholders of the Genesee Light and Power Company the following directors were elected: Walter C. Lewis of Boston, Mass.; Rudolph F. Rabe and Adolph Luedeke of New York, George M. Kimble of Concord, N. H., and Marc W. Comstock of Buffalo. The directors chose the following officers: President and treasurer, Mr. Lewis; secretary, Mr. Comstock. The directors also named the firm of Thomas & Neal of Boston, Mass., as managing engineers.

STATESVILLE, N. C.—The Southern Power Company has begun a survey from this point to Lookout Shoals, on the Catawba River, twenty miles to the northwest, where a hydroelectric development will be undertaken, and if the complete plans of the company are carried out, about $1,000,000 will be spent on the development and in building a dam and power plant. This site is located about 100 miles up the Catawba and north of the first power site developed at Fort Mill. L.

GREAT BARRINGTON, MASS.—The Great Barrington Electric Light Company has petitioned the state board of gas and electric light commissioners for authority to issue 800 additional shares of stock at the par value of $100. The company now has $50,000 of capital stock outstanding, but proposes to purchase the title to the water power and connecting real estate and rights pertaining thereto that it has up to the present time held under lease. This, with the money necessary to pay off the company's present floating debt and for extensions and improvements needed, is expected to use the $80,000 desired.

JEFFERSONVILLE, IND.—The Jeffersonville Water, Light and Power Company has filed articles of incorporation with a capital of $150,000. The incorporators and directors are: James P. Goodrich, Winchester; Harry C. Starr, Richmond; Jesse T. Moorman, Winchester; August C. Huey, Richmond; John S. Graves, Chicago. The company is composed of the men who purchased the plant and franchises of the Jeffersonville Water Supply Company at sheriff's sale. The company is authorized to provide water for power and also gas, electric light and power plant, besides furnishing water for domestic and public use.

ELECTRIC RAILWAYS.

(Special Correspondence.)

STILLWATER, MINN.—It is reported that the Twin City Rapid Transit Company will extend its suburban lines to include Hastings and Hudson. C.

NEW CASTLE, IND.—Freight service has been inaugurated on the New Castle, Indianapolis & Toledo Traction Company's new line, and passenger service will begin in a short time. S.

FRESNO, CAL.—A stockholders' meeting has been called for March 24, to decide upon the proposed increase of the Fresno-Hanford and Summit Lake Railway Company's capital from $1,000,000 to $1,500,000. C. S. Lee is the secretary. A.

CHICKASHA, OKLA.—This city has subscribed $40,000 to the Caddo development for the purpose of building an interurban electric line connecting El Reno, Chickasha and Anadarko. A survey has been made from El Reno to Andarko.

PERU, IND.—Regular schedule service has been begun over the new Warsaw-Peru division of the Winona Traction Company's system. This line completes the trolley link in the chain of routes from the southern to the northern part of the state. S.

EVERETT, WASH.—Grading has been started at this end of the Everett-Seattle, and it is expected that cars will be running the full length of the line by March 1. Power plants for this system are to be located at Ballard, Hall's lake and Everett.

HOOD RIVER, ORE.—The Hood River Light and Power Company has been formed to begin development in the Hood River valley and to construct an electric railway from this city to the upper valley section. The survey has been made and rights of way secured.

SCRANTON, PA.—The electrification of the Moosic Lake railroad will soon be started and it is expected that electric cars will be in operation by May 1. The American Railways Company and Burke Brothers, owners of the resort, will spend about $100,000 in making the necessary changes.

BOLIVAR, N. Y.—The Bolivar-Wellsville Construction Company, incorporated, has applied to the village trustees for a franchise to build and operate an electric railway line on Wellsville and Boss streets. The proposed line is to connect Bolivar and Wellsville. It will be 19 miles long and is to cost $250,000.

PALO ALTO, CAL.—The electric railway between this city and San Jose will, according to the statement of F. E. Chapin, general manager of the Peninsula Railway Company, be in operation by the first of March. The opening of the road depends on the completion of the substation at Los Altos.

EVANSVILLE, IND.—A subsidy election has been asked for to vote on a proposad tax of $436,000 to build an interurban railroad bridge across the Ohio river. The building of the bridge is expected to unite more closely Indiana and Kentucky by a network of traction lines with Evansville as the terminus. S.

SALT LAKE CITY, UTAH.—Work on the interurban railroad, which will connect Salt Lake City with the principal towns as far south as Payson, will be commenced early this spring. The surveys have been made and the money is ready. Senator Bamberger, president of the Salt Lake and Oregon Railway Company, is at the head of the project.

MODESTO, CAL.—Laying of rails on the Modesto Interurban railway, which will connect Modesto with the main line of the Santa Fe railroad, four miles east, began recently, and it is expected that the entire roadbed to the city limits of Modesto will be completed in a very short time. A petition for a franchise in the city of Modesto is now pending.

WARSAW, IND.—The Winona Interurban Company has placed an order for five new interurban cars, eight city cars, one line car, one baggage car and eight freight cars. The opening of the Peru division made the addition of the rolling stock necessary. The company is about ready to ask for bids for the construction of new car barns, of a new shop, tools, etc., at Warsaw. S.

FT. WAYNE, IND.—The Ft. Wayne & Wabash Valley Traction Company has purchased at a cost of $12,000 a portable rotary substation which is now being mounted on a flat car. It is the first of the kind in Indiana. The car is to be constantly held in readiness to be rushed to any point on the interurban system between Ft. Wayne and Lafayette for use in the event of accident, etc. S.

OTTAWA, ILL.—Active construction work on the lines of the Rock River Traction Company, which is to build an interurban electric line from Sterling to Geneseo and thence to Rock Island, is to be started immediately. Contracts for the building of the road have been awarded the Northwestern Engineering and Construction Company of Milwaukee, and the work will be pushed from the start.

TEMPLE, TEXAS.—Walter G. Haag, of Temple, has been appointed receiver of the Temple-Belton Traction Company by Judge T. S. Maxey of the federal district court at Austin upon application of the Pennsylvania bondholders of the property. The company operates an electric line between the towns of Temple and Belton and upon the principal streets of the two places and has about ten miles of track. Mr. Haag was superintendent of the road at the time of his appointment as receiver. D.

PEORIA, ILL.—The Peoria Railway Company, which is a part of the Illinois Traction System, will spend about a quarter of a million dollars in the improvement of the property in the city. Several parts of the line will have new track, the cars now in use on the Adams street elevated line will be converted into pay-as-you-enter cars, two extensions will be built and $10,000 will be used to improve the power house. V.

PROVO, UTAH.—Jesse Knight through his attorney, D. H. Thomas, has applied to the city council of Provo for a franchise granting him the privilege of constructing a single or double track railroad on the streets of Provo, also to build pole lines for electric power and light wires. The power will be supplied by a plant now in operation at Santaquin, Utah County and one at Snake Creek, Wasatch County, both of which are owned by Mr. Knight. N.

SAN FRANCISCO, CAL.—The supervisors have passed the bill formally providing for the issuance and redemption of bonds to the amount of $2,020,000 to furnish funds for the reconstruction of the Geary Street Road, its extension to the ocean and to the foot of Market Street. Of the total amount to be raised, $1,900,000 is needed for the reconstruction and extension of the existing road, while $120,000 will be used for the extension down Market Street from Kearny to the ferries. A.

SHAWNEE, OKLA.—Amended articles of incorporation for the Shawnee Electric Railways have recently been filed. The capital stock of the company is increased from $100,000 to $1,300,000. It is proposed to run the line from Muskogee through Okmulgee and Prague to Shawnee and from Shawnee through Dale, McLoud, Harran, Choctaw City and Spencer to Oklahoma City. The incorporators are: C. T. Edwards, A. Hargraves, J. W. Rubey, J. C. Chrisney, C. E. Easterwood, R. E. Page, and W. S. Pendleton, all of Shawnee.

SAN JOSE, CAL.—L. E. Hanchett is understood to have paid the German Savings and Loan Society of San Francisco $750,000 for the so-called "First-Street Railway," thereby completing his control of all the urban street railways of San Jose and Santa Clara. This is considered an important and decisive move in the three-cornered fight for the control of the electric railway properties of Santa Clara County. This purchase may result in the extention of the Hanchett electric roads up the peninsula to San Francisco and up the east bay valley to Oakland. A.

FRESNO, CAL.—Work has been started on the construction of the interurban line between this city and Hanford. Plans for the construction of a power plant at Fowler of 1,000-kilowatt capacity have already been submitted and here all the power necessary for the operation of the road will be generated. A substation will be built at Laton. The estimated cost of the road will, in round numbers, be $890,000. The officers elected at the annual meeting were A. B. Clark, president; F. S. Granger, vice president and general manager; Charles S. Lee, secretary; George A. Yuille, treasurer.

BUTLER, PA.—The Pittsburg, Butler, Slippery Rock and Grove City Railway Company was organized by Butler and Slippery Rock capitalists to construct a trolley line between here and Slippery Rock, a distance of twenty miles. The officers are as follows: W. C. Thompson, president; J. A. Smith, secretary, and Dr. W. C. McCandless, treasurer. F. E. Barrett, a Pittsburg engineer, has been employed to make final surveys and the exact route will soon be selected. Connections will be made with the Pittsburg and Butler and the Pittsburg, Harmony, Butler and New Castle lines at Butler, and with the proposed Slippery Rock and Grove City trolley line, contracts for the construction of which will be let in March.

INDIANAPOLIS, IND.—Articles of incorporation for the Hammond, Whiting and East Chicago Railway Company capitalized at $1,000,000, divided into 10,000 shares of $100 each, have been filed with the Secretary of State. This company is organized for the purpose of purchasing the property of and taking over the Hammond, Whiting and East Chicago Electric Railway Company and the purchasing of other property, constructing, owning, leasing, maintaining and operating steel railways in Hammond, Whiting and East Chicago. Control of this system was recently secured by the interests in the Chicago City Railway Company, who merged nearly all the South Side surface traction lines in Chicago into one big company. The home office is in Hammond, and Robert S. Knox, Charles R. Moore, Samuel R. Jenkins, Frank G. Murray and Edgar H. Plank are directors. S.

SOUTH BEND, IND.—Officers of the Chicago, South Bend & Northern Indiana Railway Company were elected by the directors at a meeting held February 3, as follows: President, C. T. Deeterich, New York; vice-president, Charles Murdock, Lafayette; secretary, Samuel Murdock, Lafayette; treasurer, A. E. Dietrich, New York. At this meeting the directors considered the proposition to purchase and take over the Southern Michigan Electric Railway, a line in operation between St. Joseph, Mich., and South Bend. There was a material difference of opinion between the officers of the two companies as to the value of the property of the Michigan company and further negotiation was put off until a careful examination of the road bed can be made. If the property is purchased, the Murdock syndicate will build a branch line connecting the two systems. The acquisition of this line will enable a trolley passenger to ride from St. Joseph, Mich., to Louisville, Ky., by way of South Bend, Peru and Indianapolis.

OAKLAND, CAL.—An electric railroad franchise, asked for by the Peninsula Railway Company, has been advertised for sale. A.

LOS ANGELES, CAL.—The Board of Supervisors are receiving sealed bids for furnishing the county with one single-end 220-volt four-ton electric locomotive. A.

MT. VERNON, IND.—Plans are well under way for the construction of an electric line from this city to Marion, Ill. This proposition carried out will connect Evansville with Chicago by trolley in the near future. S.

PORTLAND, IND.—The Muncie and Portland Traction Company is preparing to extend its line from Portland to Celina, O. This line, when constructed, will pierce a section of rich farms without railroad facilities and will prove a paying investment. S.

WARSAW, IND.—Regular schedule traffic has been inaugurated on the Winona Traction Company's new line between this city and Peru. Trial trips are being made on this road and connecting roads with a view of establishig through service between South Bend and Indianapolis. S.

ANDERSON, IND.—The Indiana Union Traction Company on the morning of February 12 shifted a bridge 250 feet long over White River twenty-six feet northward without disturbing schedule traffic. The shift was made to make room for a new and heavier bridge to be erected in the spring. S.

CORDELE, GA.—Promoters are actively engaged in efforts to construct an electric railroad from Cordele to Daphne, a pleasure resort eight miles east of this city on the S. A. L. Ry., and Flint River. A large number of citizens of Cordele and Daphne and the Byrom Corporation of Byromville are interested in the scheme. B.

SAN FRANCISCO, CAL.—Dr. Hartland Law and a special committee of the Nob Hill Association have planned an electric railway line through a tunnel under Stockton street from Bush, to a point a short distance North of Sacramento street. The tunnel, as wide as the street, is to be lined with glazed brick. The grade in the tunnel is not to be over three per cent. A.

LEXINGTON, N. C.—The town of Lexington having recently granted a franchise to applicants to build a trolley line through the town, the county of Davidson is now being petitioned for a similar franchise to build an electric line through the country. These applications are understood to be part of a general plan to connect a number of towns in the section by trolley lines. L.

CHARLESTON, S. C.—The Consolidated Company will expend $100,000 in extensions and improvements, and will build four miles additional tracks for the city electric railway system, President Gadsden having already ordered $70,000 in new material for the proposed work. When this work is completed, about October 1, it is proposed to double-track the Consolidated's lines to the Charleston Navy Yard, seven miles from the center of the city. L.

DURHAM, N. C.—Announcement has it that the Durham Traction Company will install a new 1,500-horsepower, slow-speed, Corliss engine, with other new equipment. It is possible that the capacity of the electric plant will also be increased up to 5,000 horsepower. There are under consideration several extensions of the traction lines to cotton mills in East Durham and West Durham, and changes in the tracks at the Trinity College athletic field. L.

INDIANAPOLIS, IND.—The officials of the Beach Grove Traction Company announce that the interurban road connecting Beach Grove with Indianapolis will be completed within four months. The contract for construction has been awarded to the Alan Construction Company of Indianapolis. The annoucement by the Big Four road that twelve additional shop buildings would be added to the plant this year has increased the activity of the interurban road promoters. S.

ATLANTA, GA.—The Georgia Railway and Electric Company has recently handed the city of Atlanta its gross receipt tax for 1909, the tax amounting to over $59,000, an increase of $5,000 over that of 1908. This is the largest tax paid the city by any corporations, and exceeds the total paid by practically all of the public utilities companies, railroads, telephones, etc. The total tax paid the city by the electric company is $118,695.82, while the company's total paid for all taxes, is more than $250,000, for 1909. L.

SAN MARCOS, TEXAS.—The proposition of building an interurban electric railway between San Marcos and Luling, about twenty miles, has been revived. B. G. Neighbors, of San Marcos, and Joseph Jennings, of Martindale, Texas, representing local interests, have taken the matter up with New York people and a preliminary organization is being formed as the first steps towards the fulfillment of the project. The route of the proposed line is down the valley of the San Marcos River through a populous territory. The survey for the road was made some time ago. D.

GREENVILLE, S. C.—Following closely upon the formation of the Greenville, Spartanburg and Anderson Electric Railway, is the announcement that still another company, the Spartanburg and Greenville railroad, electric, has been formally chartered by the secretary of state, to build a thirty-one-mile interurban electric line between Spartanburg and Greenville. The first named road is backed by the Duke interests, which have large holdings in the Southern Power Company, while the newly chartered road numbers among its stockholders Chas. W. Ellis, president; H. H. Price, vice-president, and C. H. Yates, secretary and treasurer. The headquarters of the road are at Greenville. L.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

CORWITH, IA.—The Hancock County Rural Telephone Company is to build a toll line to Britt. P.

HINCKLEY, MINN.—The Hinckley-Kroschel Telephone Company is planning the extension of its lines. C.

MARTELL, NEB.—The Martell Telephone Company has been incorporated with a capital stock of $15,000. P.

CLEGHORN, IA.—The Liberty Central Telephone Company has been incorporated by H. J. Lowrey and others. P.

STILLWATER, OKLA.—The Paradise Telephone Company has been incorporated by Monroe Boyd and others. P.

CEDARVALE, OKLA.—The New State Mutual Telephone Company has been incorporated with a capital of $10,000. P.

TROY, MONT.—W. J. Doonan, John E. Chase and W. E. Milnor have incorporated the Troy Telephone Company with a capital of $40,000. C.

WAYNOKA, OKLA.—The Waynoka Local and Long Distance Telephone Company has been incorporated with a capital of $10,000. P.

KIEL, WIS.—The Schleswig Telephone Company will build a line to connect with the Eastern Wisconsin Telephone Company here. C.

PARKERS PRAIRIE, MINN.—The Parkers Prairie Farmers' Telephone Company has been incorporated. E. Larson has been elected secretary. C.

ABERDEEN, S. D.—The Collins Northwest Telephone and Telegraph Company will install wireless systems in North and South Dakota and Minnesota. C.

TROY, MONT.—D. T. Wood has applied for a franchise for the Fall River Telephone Company which will take over the Bull Lake Telephone Company. P.

WILMINGTON, DEL.—The Wilmington Automatic Telephone Company, with a capital of $1,000,000, has been incorporated by W. T. Spring, F. J. Hensel, J. M. Lindsay, of Wilmington.

INDIANAPOLIS, IND.—The Central Union Telephone Company has ordered plans for the construction of a large addition to the Woodruff exchange in the eastern part of the city. S.

ELLENDALE, N. D.—The Ellendale Rural Telephone Company, W. Townsend, secretary, has been organized to take over the Forbes telephone line. Considerable improvements will be made in the line. C.

BLOOMING PRAIRIE, MINN.—Subscriptions to stock in the Farmers & Merchants' Telephone Company are being received. The capital of the company is $10,000. Incorporators: G. Z. Peterson, R. K. Dock and others. C.

DELPHOS, OHIO.—A reorganization has been effected of the Delphos Home Telephone Company, recently purchased by the Lima Telephone and Telegraph Company. D. J. Cable has become the new head and John F. Lindeman, secretary and treasurer.

COLUMBUS, IND.—The Indianapolis, Columbus & Southern Traction Company is in the market for the purchase of sixty miles of copper telephone wire and other equipment for a telephone system along the entire length of the traction line. S.

EAST GRAND FORKS, MINN.—The Red River Telephone Company, of which H. W. Porteous is secretary and treasurer, has been incorporated. As soon as weather will permit a line will be built to connect with the Northwestern Telephone Exchange Company's system. C.

BUTTE, MONT.—The Intermountain Construction Company has been incorporated by Thaddeus S. Lane, of Butte, I. O. Evans, of Salt Lake, and H. R. Brown, of Butte. The company, which has a capital of $100,000, will engage in the business of constructing and operating telephone and telegraph and electric lines. C.

MISHAWAKA, IND.—The Home Telephone Company, of South Bend, has begun the work of constructing an underground trunk line between this city and South Bend. This is necessary to relieve the congested business between the two cities. As soon as completed the automatic system being installed at South Bend will be extended to this city. S.

BUTTERVILLE, IND.—The Butterville, Hyde and San Jacinto Telephone Company has filed articles of incorporation with the Secretary of State. The company proposes to build a telephone system in and connecting the three towns named in the title, with the principal exchange in Butterville. Subsequently the lines will be extended throughout Jennings County.

SULLIVAN, IND.—The Merchants' Telephone Company has been organized and is asking the city council for a franchise to build and operate a new telephone plant. The organization is the result of an action taken by the Sullivan Telephone Company increasing the rate one dollar a month on telephone service. The city council is inclined to grant the new company a franchise. S.

PIQUA, OHIO.—Arrangements have been completed for a merger of the telephone companies at Piqua, Ohio. The Central Union Company will take over the toll service of the Independent Company, which will take care of the local business. The local

exchange will be rebuilt and the capital stock of the latter increased from $100,000 to $160,000.

CANTON, N. C.—The Canton Electric and Telegraph Company, with headquarters in this town, has been granted a charter by the secretary of state, to buy or sell electric power and to operate telephone lines, the authorized capital being $100,000. G. H. Henson, J. N. Mease and R. H. Sorrells are incorporators. L.

ELECTRICAL SECURITIES.

In the address given by President Taft in New York city on Lincoln's birthday he spoke strongly for the enforcement of the law even though it might be necessary to make some changes in business methods to conform with the present laws. It is now seen that the president has no intention of destroying business, and a much better feeling prevails in Wall Street. Even the past uncertainty which has been the rule in bond values, has had the effect of raising the prices of the higher grade of bonds. The future of the market depends now upon the enforcement or non-enforcement of the present laws, and the action of the legislature in making new ones.

Stockholders of the Commonwealth Edison Company may exchange stock subscription receipts and receive stock certificates between April 30 and November 1.

Metropolitan Elevated Railway's traffic for February is running at the rate of 162,000 passengers daily, as compared with a daily average of 142,000 in February, 1909.

At the annual meeting of the Chicago Telephone Company William H. Miner was elected a director to succeed J. Russel Jones deceased. Other directors were re-elected.

The Amesbury Electric Company has petitioned the Massachusetts Gas Commissioners for authority to issue 200 shares of its capital stock, par value $20, and twenty of its first mortgage bonds, of a par value of $20,000, for the purpose of funding a portion of its floating indebtedness.

At the annual meeting of the New York Edison Company George F. Baker, William Rockefeller, George B. Cortelyou and J. W. Sterling were added to the board. Other directors were re-elected. The board now numbers eleven in all. No statement of earnings will be issued prior to reports required by the Public Service Commission.

DIVIDENDS

General Electric Company; quarterly dividend of $2, payable April 15.

Northern Texas Electric Company; $3 per share on preferred and $2 per share on common stock, payable March 1, to stockholders of record February 14.

Philadelphia Electric Company; quarterly dividend of one and one-half per cent, payable March 15.

NEW YORK.

	Feb. 14.	Feb. 7.
Allis-Chalmers common	11½	11½
Allis-Chalmers preferred	41	38½
Amalgamated Copper	76¼	77⅝
American Tel & Cable	*80	*80
American Tel. & Tel.	137	136¼
Brooklyn Rapid Transit	71¾	71½
General Electric	151½	150⅞
Interborough-Metropolitan common	20¼	18⅞
Interborough-Metropolitan preferred	50	49½
Kings County Electric	130	129
Mackay Companies (Postal Telegraph and Cables) common	88½	88
Mackay Companies (Postal Telegraph and Cables) prefd.	76	75
Manhattan Elevated	137	134
Metropolitan Street Railway	17½	18
New York & New Jersey Telephone	123½	123
U. S. Steel common	78¾	80
U. S. Steel preferred	119⅝	120¼
Western Union	71	71
Westinghouse common	68½	67
Westighouse preferred	125	125

*Last price quoted.

BOSTON.

	Feb. 14.	Feb. 7.
American Tel. & Tel.	137	136¼
Edison Elec. Illuminating	241	244
General Electric	156	150⅞
Massachusetts Electric common	19	16⅝
Massachusetts Electric preferred	80	81
New England Telephone	134	125½
Western Tel. & Tel. common	15	15
Western Tel. & Tel. preferred	89	90

PHILADELPHIA.

	Feb. 14.	Feb. 7.
American Railways	46¾	46⅜
Electric Company of America	11⅝	11⅞
Electric Storage Battery common	57½	58¼
Electric Storage Battery preferred	57½	58¼
Philadelphia Electric	14⅛	14⅛
Philadelphia Rapid Transit	26	26
Philadelphia Traction	89	88¼
Union Traction	50	50¼

CHICAGO.

	Feb. 14.	Feb. 7.
Chicago Railways, Series 1	105	105
Chicago Railways, Series 2	29½	29
Chicago Subway	3¼	3
Chicago Telephone	127	127
Commonwealth Edison	114	115½
Metropolitan Elevated common	15½	15
Metropolitan Elevated preferred	51	52½
National Carbon common	105	107
National Carbon preferred	115	116

NEW PUBLICATIONS.

INCREASING FOREST PRODUCTIVITY.—The United States Forest Service has issued Circular No. 172, devoted to "Methods of increasing Forest Productivity." The circular was prepared by E. E. Carter, assistant forester, and includes clear statements regarding increase in quantity of latest products, methods of increasing the production by increasing the area under cultivation, as well as increasing the rate of growth.

KANSAS ASSOCIATION CONVENTION MANUAL.—The Kansas Gas, Water, Electric Light and Street Railway Association has issued in attractive pamphlet form the official proceedings of its twelfth annual meeting, held at Wichita, Kas., September 23 and 24, 1909. This publication is one of considerable interest in showing to similar state associations how they may secure a good record of their convention proceedings at a very small or no cost. The bulk of the pamphlet, which contains thirty-six pages, contains advertising on the left-hand page and the proceedings on the right-hand page. The latter are given in somewhat condensed form, particularly the discussions of the papers. Such a report can very readily be prepared by the secretary of the association without the expense of engaging an official stenographer. The reports of the various officers and committees are given in full. The papers that were presented are likewise printed in full, but in smaller type. The advertisements are those of the most representative manufacturers of machinery and supplies for public utility systems and singularly are almost exclusively electrical. The secretary of the Association is James D. Nicholson, Newton, Kas.

CONVENTION REPORT OF THE ILLINOIS STATE ELECTRIC ASSOCIATION.—The Illinois State Electric Association has issued its bound volume of 146 pages, giving in detail the full proceedings of its last annual convention, held at Alton, Ill., on October 26, 27 and 28, 1909. This volume contains lists of officers for 1909 and for 1910, the past presidents of the association, the program of its last convention, and then the complete stenographic report of the proceedings, including reports of various officers and committees, all the papers that were presented, with a full report of the discussions that followed. All this matter is arranged in the order in which it was presented before the convention. There is also added a brief paper entitled "A Few Hints On Overhead Line Construction" by R. L. Flannigan, of Springfield, Ill. This paper was not presented before the convention, but it had been intended to do so. The lists of member companies of the association and of their representatives that were present at the meeting, also representatives of the manufacturers' supply dealers and allied interests that were present are given in full. The by-laws of the association are also included. The secretary of the association is H. E. Chubbuck, Mayer building, Peoria, Ill.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION.—The annual report of the Smithsonian Institution, Washington, D. C., for the fiscal year ended June 30, 1908, has just been issued. It makes a volume of 811 pages, the first eighth of which is devoted principally to the report of the secretary, Dr. Chas. D. Walcott, and the heads of the various bureaus associated with the Institution, such as the National Museum, the Bureau of American Ethnology, the National Zoölogical Park, the Astrophysical Observatory, etc. As usual the general appendix of the report takes up the bulk of the volume and may frankly be said to be the most interesting part thereof. It contains twenty-seven important scientific memoirs, chiefly addresses and papers presented before scientific and engineering societies during the calendar year 1908. Among these classical addresses are the following: "The Present Status of Military Aeronautics," by Major Geo. O. Squier, U. S. A.; "Aviation in France," by Pierre Roger Jourdain; "Wireless Telephony," by R. A. Fessenden; "Phototelegraphy," by Henri Armagnat; "On the Light Thrown by Recent Investigations on Electricity on the Relations Between Matter and Ether," by Sir J. J. Thomson; "Life and Work of Lord Kelvin," by Prof. S. P. Thompson; "The Work of Henri Becquerel," by André Broca.

PERSONAL MENTION.

EDWARD P. BURCH, of Minneapolis, Minn., has commenced a course of twelve lectures on "Electric Traction for Railway Trains" before the senior students in electric engineering at the University of Minnesota.

R. F. WHERLAND has resigned as superintendent of the Redwood Falls light and power plant at Redwood Falls, Minn., to organize a company for the transmission of current to the surrounding towns.

P. D. WAGONER has been elected president of the General Vehicle Company, Long Island City, N. Y., succeeding J. Howard Hanson, who has withdrawn from the company. Mr. Wagoner brings to his new work a wide experience in engineering and commercial affairs, and under his administration, the outlook for the future of the General Vehicle Company appears very bright.

EMIL G. SCHMIDT, general manager of the Walbridge interests in Peoria and Springfield has resigned his position with the companies in those cities. He had charge of the lighting company and the street railway systems in Springfield, and the electric light company in Peoria. Mr. Schmidt has had charge of the utilities in Springfield with the position of vice-president of the Peoria Gas and Electric Company in Peoria.

ELWIN C. FOSTER, recently president of the New Orleans Railway and Light Company and formerly vice president and general manager of the subsidiary companies of the Massachusetts Electric Companies has become associated with Sanderson & Porter, whose offices are at 52 William Street, New York city. Mr. Foster will make a specialty of conducting examinations of street railway, electric light and gas properties, and will give advice concerning their value and operation.

H. E. CHUBBUCK, general manager of the Illinois Traction System, has been appointed to the position of vice-president of the entire system, thus becoming the head of the board of directors and ranking next to President W. B. McKinley. Mr. Chubbuck has had the active management of the system for the last two years and has developed the property to one of the largest electric interurban railway systems in the country. The Illinois Traction System owns several electric lighting and power plants in the state. Mr. Chubbuck is secretary of the Illinois State Electric Association, which office he has held for a number of years.

H. E. CHUBBUCK.

JAMES M. WAKEMAN has resigned the vice-presidency of the McGraw Publishing Company, New York city, and will be succeeded by Hugh M. Wilson, the well-known former publisher of the *Railway Age* and the *Electric Railway Review*. Mr. Wakeman retires for a rest from business cares, and his plans include a visit to Europe for a year. Mr. Wakeman is an able and enterprising publisher, and his departure will be regretted by hosts of friends. Mr. Wilson, his successor, is a widely known and successful publisher, and for the past two years has been connected with the Barney & Smith Car Company as vice-president, which office he resigns to take up his present work.

NEW INCORPORATIONS.

NORTH ADAMS, MASS.—The Massachusetts Carbon Company has been incorporated to manufacture and sell carbon of all kinds, with a capital of $90,000. G. Maxwell is president, and H. C. Tower, treasurer.

NEW YORK, N. Y.—The United Track and Wheel Brake Company, with a capital of $1,000,000, has been incorporated by M. B. Bloomer, Westfield, N. J.; C. E. Smith, Sheepshead Bay, N. Y., and J. K. Duffy, New York city. The company will manufacture and sell brakes and other railway appliances.

BIRMINGHAM, ALA.—The Barbour Plumbing, Heating and Electrical Company has been formed here, with a capital stock of $25,000, fully paid in, and will engage in business immediately. Officers have been elected as follows: B. C. Rickman, president; C. B. Barnit, vice-president, and J. A. Selman, secretary-treasurer.

POUGHKEEPSIE, N. Y.—The Bullock Safety Appliance Company, Poughkeepsie, N. Y., has been incorporated to manufacture and deal in electrical supplies, particularly electrical alarm and signal apparatus; capital, $50,000. The incorporators are: Peter H. Troy, Poughkeesie, N. Y.; Henry F. White, New York, N. Y.; J. Somers McClellan, Albany, N. Y.

SELMA, ALA.—Papers of incorporation have been filed here for the Reeves-Walker Electric Company; incorporators are Raymond R. Reeves, R. M. Walker, and Margaret F. Reeves. The capital stock is $10,000. Officers are: R. M. Walker, president, and R. P. Reeves, secretary and treasurer. The concern will engage in a general electric and plumbing business. B.

PROPOSALS.

POST OFFICE, LINCOLN, ILL.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until March 21, for the construction complete (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the United States Post Office at Lincoln, Illinois, in accordance with the drawings and specifications, copies of which may be obtained from the Custodian of site at Lincoln, Ill., or at the Supervising Architect's office.

POST OFFICE, FREMONT, NEB.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until March 22, for the extension, remodeling, etc. (including plumbing, gas piping, heating apparatus, electric wiring and conduits), of the United States Post Office at Fremont, Neb., in accordance with drawings and specifications, copies of which may be had from the custodian at Fremont, Neb., or at the Supervising Architect's office.

POST OFFICE, LEXINGTON, KY.—The office of the Supervising Architect, Washington, D. C., will receive sealed bids until March 25 for the extension, remodeling, etc. (including plumbing, gas piping, heating apparatus, electric conduits and wiring), of the United States Post Office at Lexington, Ky., in accordance with drawings and specifications, copies of which may be had from the Custodian at Lexington, Ky., or at the Supervising Architect's office.

NAVY DEPARTMENT SUPPLIES.—The Bureau of Supplies and Accounts, Navy Department, Washington, D. C., will open bids on naval supplies on the dates given below. Bidders interested therein should make early application for copies of the schedule, giving the schedule numbers desired. Schedules can be obtained from the Navy Pay Office nearest each navy yard. Bids will be asked on the following supplies:

Date of Opening.	Material.	Quantity.	Delivery at Navy Yard.	Schedule No.
March 1..	Telegraphs, steering, etc.	3 sets	Norfolk, Va.	2241
	Cable, single conductor	41,000 feet	Newport, R. I.	2247
	Cards, receiver	200	Brooklyn, N. Y.	2258
	Fuses, glass tube	75,000	" "	2258
	Fuses, glass tube	Miscellaneous	" "	2258
	Jars, Leyden	600	" "	2258
	Motors and pumps	2	Norfolk, Va.	2240
	Sal ammoniac	2,000 pounds	Brooklyn, N. Y.	2259
	Searchlights, 13-inch	2	" "	2256
	Zinc for Le Clanche Gonda cells	3,000	" "	2258
	Lathe, screw cutting, 18-inch	1	Norfolk, Va.	2242

INDUSTRIAL ITEMS.

THE VALENTINE-CLARK COMPANY, Chicago, Ill., dalers in northern and western cedar poles, ties and pilings, is distributing an attractive booklet which explains the history of the well-known V-C poles from their origin in the forest to their use. The various processes that the poles go through are described and illustrated and the facilities for shipping the poles explained in detail. In addition it contains some interesting data on weights and sizes of poles.

THE NATIONAL ELECTRIC SPECIALTY COMPANY has been incorporated at Toledo, Ohio, with a capital stock of $50,000. It will manufacture lighting arresters, soldering devices and other telephone and telegraph supplies. S. O. Richardson of the Libbey Glass Company will be president of the new concern and a suitable site will be selected near the Libbey Glass plant. The incorporators were: C. A. Atwell, Chas. S. Northrup, Paul Chapman, C. J. Nolan and Louis D. Chapman. H.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., has just issued a bulletin, known as No. 119, devoted to low reading, pocket voltmeters designed especially for battery testing. The instrument described is the watch case type, constructed on the D'Arsonval principle. It is of rigid construction, heavily nickel plated and the mechanism is similar to that of the high priced portable voltmeters. Several illustrations show the instrument when in operation, when packed and all of the parts in detail.

THE WESTERN ELECTRIC COMPANY has recently distributed a booklet devoted to automatic intercommunicating telephones. This besides being neatly arranged and illustrated, contains considerable descriptive matter of these types of intercommunicating telephones. It also gives a description of the cable terminal, connecting block, batteries and battery boxes used in connecting with these sets which are for use in business houses and residences. They include metal wall types, both flush and non-flush, and desk sets for office use.

THE SANGAMO ELECTRIC COMPANY, Springfield, Ill., has ready for distribution a new bulletin, known as No. 17, which deals fully with Sangamo ampere-hour meters for direct-current circuits. These meters are especially adapted for use with storage batteries wherever employed. These instruments were described in former bulletins Nos. 14 and 15 but rapid development together with new added features now makes them incomplete. In this publication, therefore, are presented the new features, new applications and improvements of design. A number of tables, diagrams and photographs help towards making this bulletin valuable to those interested.

THE UNITED STATES LIGHT AND HEATING COMPANY, New York, N. Y., has ready for distribution a publication which will be favorably received by those who have any thing to do with the care and operation of storage batteries for pleasure and commercial vehicle service. This "Instruction Book" as it is called will provide complete information relative to National batteries for electric vehicle service for owners, operators, garage attendants and in fact all others who desire to familiarize themselves with every detail of the subject. Attention is called to the fact that these instructions are based on long experience and expert knowledge of National batteries.

THE PETTINGELL-ANDREWS COMPANY, Boston, Mass., is distributing the February number of *Juice*, its regular monthly publication, which maintains the higher standard set by the January enlarged issue. The leading article supplies the historical background for the trade word "Mazda" now coming into prominence. An attractive article on the Jandus line of street fixtures is followed by the first of a series of biographical sketches, entitled "Pioneers of Electricity," devoted in this issue to Sir William Gilbert. Announcement of the forthcoming appearance of a new catalogue of the company, an article on "O. K." weatherproof wire and the editorial are other interesting features.

JULES RACINE & COMPANY, 103 State Street, Chicago, importers and wholesale dealers in watches, makes a specialty of

complicated watches and movements for all scientific purposes. This firm supplies the well-known Guinand's split second, non-magnetic timers and chronographs, which maintain remarkable accuracy and are used by racing judges, laboratories and in electrical manufacturies. These Swiss watches are furnished in nickel, gun metal, silver, gold filled and solid gold cases, and are strongly endorsed by those who have occasion to use time pieces requiring the most exacting service. Electrical engineers, professors, electric light and telephone companies are among the company's most satisfied customers. Jules Racine & Company will be pleased to mail a booklet describing its products on request.

THE CUTLER-HAMMER MANUFACTURING COMPANY, of Milwaukee, Wis., has issued a 128-page booklet in which the control of electrically operated elevators is very fully covered. This company has been engaged in the manufacture of electric controlling devices for many years and their booklet on Elevator Controllers is more than a mere catalogue, being in fact a concise treatise on this subject, on which so little has been published. The first section of the booklet contains illustrated descriptions of full magnet and semi-magnet direct-current controllers for high-speed, moderate-speed and slow-speed passenger and freight elevators, together with descriptions of sidewalk lift controllers, reversible and non-reversible controllers for use where current conditions are extremely variable. Illustrations and descriptions are also given of such necessary elevator accessories as brake magnets, car switches, limit switches, etc. The second section of the booklet is devoted to similar controllers for use on alternating-current circuits and the concluding pages contain tables of useful information, including suggestions regarding the proper type of motor to use in each case.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is distributing three publications devoted to tungsten lighting. Pamphlet 3907 is entitled "A Revolution in Lighting Due to a New Lamp." It calls attention to the marked improvement in electric lighting, made possible by the recently perfected Mazda lamp, and describes the latter's advantages in detail. Pamphlet 3894 is entitled "Building Lighting With General Electric Tungsten and Tantalum Lamps." A dozen large office and mercantile buildings and hotels are illustrated, in which there are extensive installations of the high-efficiency metallic-filament lamps. Renewals in these installations are being generally made with Mazda lamps. This pamphlet also contains some valuable illumination data. Bulletin 4689, entitled "Ornamental Street Lighting with Tungsten Lamps," is an attractive pamphlet of twenty-four pages, in which the present tendency toward decorative and yet effective street lighting is explained with the aid of nearly a dozen illustrations of typical street scenes in various American cities by day and night, and of over a score views of the ornamental standards used. Most of the latter carry five lamps, four brackets and a globe at the top, but there are shown many deviations from this custom. Several good examples of arch lighting are also illustrated. The bulletin contains a clear exposition of the benefits of better street lighting and shows how this may be obtained economically through the use of the tungsten lamp.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) February 8, 1910.

948,303. AUTOMATIC DEVICE FOR CONTROLLING WATER-SUPPLY. James A. Anderson, New York, N. Y., assignor to Montauk Engineering Company, New York, N. Y. Filed July 17, 1908. Renewed July 3, 1909. The water supply is controlled by an electromagnetically operated valve. An electric telltale alarm is also provided.

948,321. KNOB-INSULATOR. Sergius P. Grace, Pittsburg, Pa., assignor to Western Electric Company, Chicago, Ill. Filed June 12, 1907. The insulator comprises a spool-like piece with the central hole countersunk at each end and the circumferential groove divided into two smaller grooves at the bottom by a shallow rib.

948,343. ELECTRIC FURNACE AND METHOD OF OPERATING THE SAME. Augustin L. J. Queneau, Philadelphia, Pa. Filed November 29, 1909. The method of treating a bath of molten metal in an electric furnace consists in providing the bath with a connection likewise of molten metal, and passing through the molten metal connection an electric current so proportioned to its cross section as to cause a series of disruptions of the connection, alternating with a series of re-establishments of the connection by the hydrostatic pressure due to the bath.

948,348. APPARATUS FOR PRODUCING HIGH-FREQUENCY OSCILLATIONS. Isaac Schönberg, St. Petersburg, Russia, assignor to Simon Eisenstein, St. Petersburg, Russia. Filed March 19, 1909. An oscillatory circuit has in it a sparking gap and a rectifier whereby the first half of an oscillation is permitted to pass in one direction and the other half is not permitted to return in the opposite direction.

948,361. TRAIN-STOPPING AND SIGNAL-ACTUATING MECHANISM. Jean F. Webb, Jr., New York, N. Y., assignor to The Electric Signagraph and Semaphore Co., New York, N. Y., Incorporated. Filed March 1, 1909. The valve is retained in a closed position by an electromagnetic device.

948,372. PROCESS FOR PRODUCING OXIDES OF NITROGEN FROM THE AIR. Francis I. du Pont, Wilmington, Del., assignor to The E. I. du Pont de Nemours Powder Company, Wilmington, Del. Filed November 14, 1908. Air in contact with a non-conducting cooling surface is subjected to the action of a rotating arc extending between the electrodes longitudinally of the non-conducting cooling surface and against the cooling surface, whereby the high heating by the arc is immediately and rapidly reduced.

948,374. ELECTRIC-MOTOR-CONTROLLING DEVICE. Frank A. Hayes, New York, N. Y. Filed September 30, 1908. Describes a combined motor and circuit reversing switch.

948,379. BATTERY ELECTRODE-SUPPORT. Charles B. Schoenmehl and Wilfred Straw, Waterbury, Conn.; said Straw assignor to said Schoenmehl. Filed August 4, 1909. An electrode support for batteries comprises in part a top cross yoke, a hanger including a bottom and side portions adjustably connected together (these side portions having eyes in their upper ends), and means for securing the yoke and eyes together.

948,381. MAGNETIC TRACTION-WHEEL DRIVE. Campbell Scott, Yonkers, N. Y., assignor to Otis Elevator Company, Jersey City, N. J. Filed December 16, 1905. In combination with an electromagnetic sheave, are means for automatically inserting resistance in circuit with the windings of the sheave.

948,404. AIR-OPERATED ELECTRICALLY-CONTROLLED VALVE MECHANISM FOR AIR-BRAKE AND TRAIN-STOPPING SYSTEMS. Jean F. Webb, Jr., New York, N. Y., assignor to The Electric Signagraph and Semaphore Company, New York, N. Y. Incorporated. Filed April 7, 1909. A valve adapted to open by pressure from within is held closed by an electromagnet device when the magnet is energized.

948,405 and 948,406. AIR-OPERATED ELECTRICALLY-CONTROLLED VALVE MECHANISM. Jean F. Webb, Jr., New York, N. Y., assignor to The Electric Signagraph and Semaphore Company, New York, N. Y., Incorporated. Original application filed April 7, 1909. Divided and this application filed August 18, 1909. An air-operated electrically controlled valve mechanism comprises a valve casing having an outlet port, a slide valve controlling the port, means for establishing a fluid pressure within the casing, and electromagnetic lever devices for holding the valve against the fluid pressure.

948,424. SHIP-DETECTOR. Frank S. Long, U. S. Army. Filed February 21, 1908. An electric circuit is closed, thereby lighting a distant lamp at a shore station, by the magnetic influence of a passing ship at any of various points.

948,436. POWER TRANSMISSION. John G. P. Thomas, Holywell, England. Filed November 5, 1908. Describes an electromechanical system of power transmission.

948,438. SWITCH BOX OR CASING. Joseph S. Ziegler and Charles T. Woodburn, Altoona, Pa. Filed July 15, 1907. The switch box has outwardly projecting attaching lugs, and inwardly projecting lugs formed with stops, in combination with an end-piece provided with ears to engage the inwardly projecting lugs, and a projection for attaching the end-piece to the back wall of the box.

948,440. APPARATUS FOR MILKING COWS. Franz M. Berberich, St. Louis, Mo. Filed April 6, 1908. Comprises a teat cup, a metal contact arranged on the inner face thereof, an electric conducting wire connected to the contact, and an electric-current generator connected to the wire.

948,441. ELECTRIC SWITCH. Daniel G. Butts, Chicago, Ill., assignor to General Electric Company. Filed April 20, 1909. The switch comprises a pivoted contact member, a spring fulcrum therefor, a cam engaging one end of the contact, and means for actuating the cam.

948,442. CONTROLLER. Frank E. Case, Schenectady, N. Y., assignor to General Electric Company. Filed November 2, 1908. An emergency device can be operated by a limited sliding movement located on the controller handle.

948,444. CONTROLLER. Arthur T. Crocker, Schenectady, N. Y., assignor to General Electric Company. Filed November 2, 1908. An emergency device can be operatively connected with the handle of the controller by downward pressure on the handle.

948,451. SUBWAY. George W. Jackson, Chicago, Ill. Filed April 6, 1906. The subway has sections for the passage of railway cars, and is provided with a raised platform between these passageways, sections on either side of the car passageways for the passage of gas, water pipes and electric wires, all of the sections being divided off from the whole subway by structural metallic work, which serves to support the pavement. A false

roof is provided for the subway, whereby ventilating and service distribution spaces are left above the railway and adjacent passageways and additional lateral passageways of reduced depth.

948,483. INDUCTOR-GENERATOR FOR IGNITION PURPOSES. Henry J. Podlesk, Chicago, Ill., and Tesla E. Podlesak, Morristown, N. J. Original application filed September 25, 1901. Divided and this application filed January 28, 1908. A magnetic field-frame is adjustably mounted on the shaft of an internal-combustion engine, the magnetic flux through the winding on this being varied by a movable inductor.

948,504. INCUBATOR-ALARM. Perry Flora, Owingsville, Ky. Filed April 16, 1909. An electric alarm is associated with a movable damper.

948,542. METHOD OF TREATING CANS OF ALKALINE STORAGE BATTERIES. Thomas A. Edison, Llewellyn Park, Orange, N. J. Filed September 29, 1904. The process of treating the cans or receptacles of alkaline storage batteries, consists in applying a microscopic film of non-saponifiable oil to the exterior thereof for the prevention of the formation of crystals of the alkaline salt on the exterior of the receptacles.

948,558. STORAGE-BATTERY ELECTRODE. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. Original application filed March 30, 1905. Divided and this application filed December 3, 1906. An active mass for storage battery electrodes comprises a compressed agglomeration of active particles individually surrounded by flake-like conducting material.

948,560. AUTOMATIC MOTOR-CONTROLLER. Arthur E. Handy, Cranston, R. I. Filed March 31, 1909. In the operating circuit of an electric motor are a number of circuit-changers; separate electromagnetic means are arranged to operate the circuit-changers individually by transfer of the magnetic balance in each; and means operated by the motor are adapted to transfer the magnetic balance in each electromagnetic means successively.

948,563. ELECTRIC-CABLE CONNECTION. William J. Littlehales, New Britain, Conn. Filed January 28, 1909. A cable clip comprises a stationary jaw having a recess, a resilient movable jaw pivoted to the stationary jaw and having a cam-shaped projection adapted to enter the recess for closing the jaws.

948,564. FOUR-WAY ELECTRIC SNAP-SWITCH. Walter S. Mayer, Philadelphia, Pa., assignor to The Machen & Mayer Electrical Manufacturing Company, Philadelphia, Pa. Filed August 26, 1907. The contact fingers are arranged in pairs at the opposite ends of contact members.

948,567. ELECTRICAL RECEPTACLE. Frank J. Russell, New York, N. Y. Filed June 17, 1909. The receptacle comprises a body, a plug holder, including a flexible wire supporting section having a base coil of less diameter than the main portion fitted against the body, and means within the section for clamping the base coil against the body.

948,596. TERMINAL CLAMP. Herman F. Richter, Seattle, Wash., assignor of one-tenth to Joseph R. Ketcham, Seattle, Wash. Filed August 3, 1908. The base has an angularly disposed flange; a disk is supported eccentrically on the base for rotary movement in either direction into clamping relation to the flange of the base, this disk having a projecting portion on its outer edge restricting the space between it and the flange of the base and tending to crowd the wire on the flange against the base.

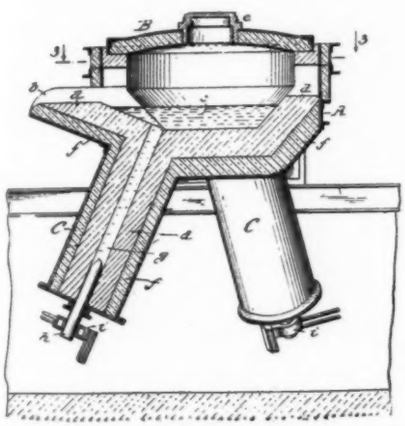
948,599. APPARATUS FOR ELECTROSTATIC MAGNETIC SEPARATION. Henry M. Sutton, Walter L. Steele and Edwin G. Steele, Dallas, Tex. Filed December 27, 1906. The particles of the mass to be acted upon are subjected to the action of a static charge regulated to produce and maintain dielectric polarity on some of the particles opposite to that of one electrode while in the magnetic field, and means are provided for separately collecting the separated particles.

948,609. WIRELESS-TELEPHONE TRANSMITTER Albert A. Jahnke, San Francisco, Cal., assignor to one-half to Susan C. Tate, San Francisco, Cal. Filed September 21, 1908. The transmitter comprises oppositely disposed mica sheets, cup-shaped terminals carried by these sheets, means for supplying the terminals with a volatile liquid, granular material between the sheets, electrodes carried by the sheets, and means for moistening the granular material with the volatile liquid.

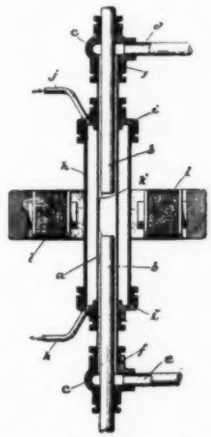
948,624. ELECTROMAGNETIC SWITCH. Roy V. Collins, New York, N. Y., assignor to American Automatic Switch Company, New York, N. Y. Filed March 16, 1908. In combination with electrically operated mechanism is an electric switch having two magnets arranged in series relation with each other, one of the magnets being adapted to be placed in parallel with the mechanism.

948,639. ACCUMULATOR. Max Schneider, Radebeul, near Dresden, Germany. Filed September 9, 1908. The positive pole electrode consists of funnel-shaped lead lamellæ and a common axle for the latter; the negative pole electrode consists of a split ring envelope arranged around the positive electrode; and metal rings around the envelope hold the same in place.

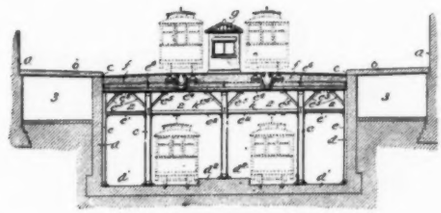
948,648. AUTOMATIC CIRCUIT-CONTROLLER FOR WATER-PURIFYING APPARATUS. Harry B. Hartman, Pittsburg, Pa., assignor to McDowell Manufacturing Company, Pittsburg, Pa. Filed October 18, 1907. A circuit controller-operating device for liquid-purifying apparatus, comprises a conduit, a valve therein arranged to be actuated by the liquid pressure and normally to close the conduit, and a circuit closer operated from the valve and arranged to close the electric circuit before the valve opens the conduit and to break the electric circuit after the valve closes the conduit.



948,343.—ELECTRIC FURNACE.



948,372.—PROCESS OF PRODUCING OXIDE OF NITROGEN.



948,451.—SUBWAY.

948,663. METHOD OF COATING METALS BY CEMENTATION. Alfred Sang, Bellevue, Pa. Filed January 2, 1909. The method consists in burying or immersing the article to be coated in a metallic coating material, and passing an electric current through the article to heat it to a sufficient temperature to cause the deposition of the coating material thereon.

948,670. ELECTRIC-LAMP SOCKET. William S. MeLewee, Yardley, Pa., assignor to Carrie Howell McLewee, Yardley, Pa. Filed February 18, 1908. Describes a form of chain-actuated socket and switch.

948,674. CABLE-SUPPORT FOR TERMINAL OR JUNCTION BOXES. Harry H. Nicholson, Evanston, Ill. Filed March 26, 1909. Describes a supporting device for a cable pothead.

948,681. ELECTROLYTIC SEPARATION OF METAL. Edwin M. Chance, Philadelphia, and Eleanor Kent, Lansdowne, Pa. Filed April 16,1908. The method consists in subjecting to the passage of an electric current, a fused metalliferous anode, and a fused electrolyte whose anion has selective affinity for a metallic component or components of the anode; and depositing the selective metallic component or components at the cathode.

948,704. CIRCUIT-BREAKER FOR ELECTRICALLY-HEATED DEVICES. William G. Nagel, Toledo, Ohio. Filed February 11, 1909. Comprises a reversible fuse-shell, a fusible substance normally held in suspense therein, but released by excessive heat conditions, means at the lower end of the shell whereby the normal condition of the shell may be restored upon being reversed after a descent of the substance, and indicator means

movably carried at each end of the shell and fixed against movement relative thereto by the substance when at the end therewith.

948,707. INSULATING MEANS FOR FLUSH SWITCHES. Clarence D. Platt, Bridgeport, Conn. Filed June 12, 1909. An improvement in flush switches comprises an insulating base provided with a recess, and an insulating block located within the recess and having cut away portions co-operating with the walls of the recess to form pockets adapted to support and insulate the switch terminals and binding screws.

948,736. SYSTEM OF ELECTRIC GENERATION, DISTRIBUTION AND CONTROL. Lamar Lyndon, East Orange, N. J. Filed July 6, 1905. Includes an alternating-current generator, a mercury rectifier, a storage battery, etc.

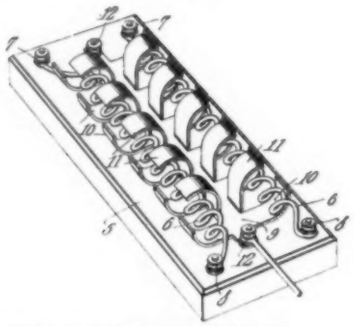
948,738. SIGNALING SYSTEM AND APPLIANCES. James G. Nolen, Chicago, Ill., assignor to John E. Shepherd, Chicago, Ill. Filed March 8, 1906. Two independently driven signaling wheels are electrically controlled.

948,753. PAY-STATION BOX FOR TELEPHONES. Clarence A. Anderson, Salina, Kans. Filed October 5, 1908. Has interconnecting features for the coin receptacles.

948,754. INCANDESCENT-LAMP SOCKET. Fredrick C. Aschenbrener, Chicago, Ill., assignor of one-fourth to himself, one-half to Joseph C. Seyl, and one-fourth to Oscar H. E. Fritz, Chicago, Ill. Filed February 27, 1909. Describes a form of chain-actuated socket and switch.

948,757. VOTING MECHANISM. Mark A. Dees, Pascagoula, Miss. Filed March 12, 1909. The punches for recording yea and nay votes are electrically selected.

948,758. SIGNAL SYSTEM FOR ELECTRIC CARS. Francis S. Denneen, Mansfield, Ohio, assignor to The Ohio Brass Company, Mansfield, Ohio. Filed March 13, 1909. Auxiliary lights are provided in a circuit normally interrupted from a battery charged from the main-line circuit.



948,873.—LIGHTNING-ARRESTER.

948,764. ELECTRIC WELDING, BRAZING, OR SOLDERING. Oscar Kjellberg, Gottenborg, Sweden. Filed August 13, 1907. The method consists in passing a current to form an arc between the electrode and the parts to be welded and then moving the electrode in a line parallel to the part where the solder is to be applied while held at a sharp angle to the line of movement, so that the soldering material will pass from the electrode in a continuous stream and be applied in rows and layers to the parts to be welded.

948,789. SUSPENSION DEVICE FOR TROLLEY-WIRES AND THE LIKE. George A. Mead, Mansfield, Ohio. Original application filed Nov. 12, 1906. Divided and this application filed Oct. 7, 1907. Describes a form of hooked connector.

948,817. DYNAMO-ELECTRIC GENERATOR. George Lewis, Newark, N. J. Filed April 8, 1909. Comprises a revoluble table carrying an inclosed field magnet and a plurability of motors having each a spring-pressed driving wheel, and an armature and commutator, and a flywheel secured to the shaft of the armature, the driving wheels peripherally engaging the flywheel.

948,819. APPLIANCE FOR SYSTEMS OF ELECTRICAL DISTRIBUTION. George A. Lutz, Plainfield, N. J., assignor to American Circular Loom Company, Portland, Me. Filed Nov. 28, 1908. Renewed, Jan. 4, 1910. A metal appliance for a system of electrical distribution has a non-electrodeposited conductive coating upon its surface and an electrodeposit upon such coating.

948,865. CONDUIT FOR ELECTRIC CONDUCTORS. George A. Lutz, Plainfield, N. J., assignor to American Circular Loom Company, Portland, Me. Filed Dec. 18, 1908. A metal conduit has a metal deposit on its inner surface, and a coating comprising graphite upon the deposit to prevent rusting of the conduit through the pores of the deposit and maintain conductivity of the conduit through the deposit.

948,873. LIGHTNING-ARRESTER. Bowen E. Clarkson, Kingstree, S. C. Filed Feb. 27, 1909. Compresses a base, choke coils arranged on the base side by side but spaced apart and a plate secured on the base between the coils, the plate being slit inwardly from its longitudinal edges toward its middle whereby to afford a plurality of fingers, every other one of the fingers at each side of the plate being bent to extend around and beneath the adjacent choke coil, the remaining fingers at each side of the plate being bent around over the adjacent coils.

948,899. SECTION-INSULATOR. Robert S. McFeely. Scalp Level, Pa. Filed May 4, 1909. Comprises a body of insulating material, end pieces a conducting material, and a trolley wheel bar having a tongue at one end to engage a recess in one of the end pieces, and spring means at its other end to form a detachable spring engagement with the other end piece.

948,926. ARC-LIGHT ELECTRODE. Isador Ladoff, Cleveland, Ohio, assignor of thirty one-hundredths to Philip C. Peck, New York, N. Y. Filed Sept. 14, 1909. The upper electrode (anode) contains an alloy of nickel and chromium.

948,941. TELEPHONE CALL SYSTEM. William E. Zabst, Portage, Wis. Filed April 27, 1909. A vibratory signal member may be yieldingly held in a definite position.

948,968. MEANS FOR PREVENTING THE CORROSION OF THE INTERNAL PARTS OF BOILERS DUE TO ELECTROCHEMICAL ACTION. Peregrine E. G. Cumberland, St. Kilda, Victoria, Australia. Filed Dec. 22, 1908. Electrodes (anodes) introduced within the boiler, and also the boiler shell (acting as a cathode), are connected to a source of current.

948,971. ARC-LAMP. Mariano Fortuny, Paris, France. Filed Jan. 10, 1906. One of three windings of a motor field-magnet is arranged in series with the arc and the other two in shunt with the arc but in series with each other, etc.

948,979. LINE SIGNAL SYSTEM. Harold D. Stroud, Chicago, Ill., assignor to The Stroud International Measured Service Company, St. Louis, Mo. Filed May 13, 1904. Describes a telephone system.

REISSUE.

13,081. INCANDESCENT-LAMP SOCKET. Robert R. Miller, Toledo, Ohio, assignor to Pass & Seymour, Inc., Solvay, N. Y. Filed Dec. 9, 1907. Original No. 813,568, dated Feb. 27, 1906. The circuit is made and broken by a rocking lever.

PATENTS THAT HAVE EXPIRED.

Following is a list of electrical patents (issued by the United States Patent Office) that expired February 14, 1910:

491,551. ELECTRICAL SIGNALING APPARATUS. Jacob B. Currier, Lowell, Mass.

491,532. ELECTRIC GOVERNOR FOR SIGNALING CIRCUITS. Jacob B. Currier and David H. Rice, Lowell, Mass.

491,548. ELECTRIC ARC LAMP. Frederick D'A Goold, Schenectady, N. Y.

491,553. TRUNK-LINE SIGNALING APPARATUS AND CIRCUIT FOR TELEPHONE EXCHANGES. Edward J. Hall, Morris, N. J.

491,561. INCANDESCENT LAMP SOCKET. Joseph Hutchinson, New York, N. Y.

491,567. CONDUCTOR FOR ARMATURES. Emil Kolben, Schenectady, N. Y.

491,568. ARMATURE AND MEANS FOR SUPPORTING THE SAME. Emil Kolben, Schenectady, N. Y.

491,595. TELEGRAPH TRANSMITTER. Robert S. Roberts, Philadelphia, Pa.

491,596. ELECTRIC LAMP FIXTURE OR BRACKET. Jas. T. Robb, Mount Vernon, N. Y.

491,603. DUPLEX ELECTRIC ARC LAMP. Chas. E. Scribner, Chicago, Ill.

491,604. ELECTRIC ARC LAMP. Chas. E. Scribner, Chicago, Ill.

491,605. CUT-OUT FOR ARC LAMPS. Chas. E. Scribner, Chicago, Ill.

491,609. TRACK CIRCUIT. Joseph B. Stewart, Haverstraw, N. Y.

491,666. ELECTRIC LOCOMOTIVE. Sidney H. Short, Cleveland, Ohio.

491,667. DIRECTLY CONNECTED MOTOR FOR CARS. Sidney H. Short, Cleveland, Ohio.

491,682. BUSHING FOR INCANDESCENT LAMP SOCKETS. Cromwell A. B. Halvorson, Saugus, Mass.

491,684. MANUFACTURE OF SECONDARY BATTERY ELECTRODES. Robert McA. Lloyd, New York, N. Y.

491,688. SWITCHING SYSTEM FOR TELEPHONE EXCHANGES. Chas. E. Scribner, Chicago, Ill.

491,692. TIME CIRCUIT CLOSER. Robert H. Twigg, London, England.

491,695. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINE. Jas. J. Wood, Brooklyn, N. Y.

491,707. ELECTRICAL INSULATING CONDUIT. Chas. W. Jefferson, Schenectady, N. Y.

491,708. ELECTRIC MOTOR AND DYNAMO MICA INSULATOR. Chas. W. Jefferson, Schenectady, N. Y.

491,713. ELECTRIC HEAD LAMP. Wm. Main, Brooklyn, N. Y.

491,824. ELECTRIC ALARM MONEY DRAWER. Wm. J. Walker, St. Louis, Mo.

491,829. ELECTRIC MOTOR REGULATOR. Joseph A. Williams, Canal Dover, Ohio.

491,857. ELECTRIC LOCOMOTIVE. Frank B. Rae, Detroit, Mich.

491,874. ELECTRIC SIGNAL. Frank H. Clarke, Springfield, Ohio.

491,893. TELEPHONE CALL. John H. Kinsman, Bridgeport, Conn.